FLIGHT
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First Aero Weekly in the World

Founder and Editor: STANLEY SPOONER

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EDITORIAL COMMENT

EVEN before the war it was to some extent the fashion to believe that the whole future of aviation lay with the aeroplane and that the airship bore about the same relation to the former as the spherical balloon does to the dirigible itself. A reference to the files of "FLIGHT" will show that we have never subscribed to that belief and that we were at some pains to combat the point of view we have indicated. It must be admitted that the almost complete failure for its intended purpose of the Zeppelin during the war, added to very sparse information available about the development of the airship in Allied countries and particularly in Britain, has tended to accentuate the belief that the lighter-than-air vessel must in the nature of things take second place to the aeroplane. So much so, that in all the recent discussions that have taken place regarding commercial aviation and its development, the airship has been almost completely ignored, and the talk has almost entirely centred about the aeroplane. It will not do, however, to ignore the possibilities of the lighter-than-air craft, which, for its own purposes and within its own limitations, has, we are convinced, an enormous field of usefulness before it. Before we go any farther, it will be as well if we remember that the lessons of the war have, so far as the aeroplane is concerned, been learnt in the open, so to speak. Its work has been of a kind which it was utterly impossible to keep secret, since it was seen by the eyes of millions. Everyone who took the trouble to follow the war news—and everyone did—was kept thoroughly posted in the broad lines of development. When the German air service was at the zenith of its power, the man in the street was fully informed of the types of machines with which the enemy was provided, together with a great many particulars of their construction and engine power. When the answer was found and provided to those types, he was almost equally well-informed regarding our own, for the sufficient reason that by the time our new machines were in commission the enemy knew all about them and there was thus no need for concealment, while, again, there were so many eyes to see them that the fact could not be concealed that we had a triplane, for instance, which was far faster and climbed better than anything the Germans had. Therefore, the general public was kept pretty well informed on the wide lines of aeroplane development.

The Future of the Airship

It was far otherwise in the case of the airship. After the first few Zeppelin raids and when our defences had been perfected, these craft had no luck at all and the last great attempt at aerial invasion by airships, which resulted in the loss of eight of the fleet, finally discounted the Zeppelin in the eyes of the public, which almost ceased to seriously regard lighter-than-air vessels. True, it was known in a general sort of way that we were employing small airships for various purposes connected with coast defence and against the submarine, but there were few who had any appreciation of the real amount of work that was being carried on by these ships. Even among those intimately connected with aviation on the heavier-than-air side there was very little knowledge of what was being done in the other direction. Some of the facts and data connected with airships and their possibilities in the development of commercial services are now given in a pamphlet issued by the Air Ministry last week, called "Notes on Airships for

Commercial Purposes." The text of this pamphlet we are publishing in full as a matter of record, so that there is no need to quote from it here, but we are quite certain that those of our readers who take the trouble to study these "Notes" will find themselves considerably surprised at the favourable comparisons they contain between the two types of aircraft. They are in no sense an argument for the airship *versus* the aeroplane. On the contrary, the compilers of the "Notes" have manifestly approached the subject in a purely statistical frame of mind and have contented themselves with simply setting down the comparative facts as they affect each type. The figures may be taken as accurate, since they are based on a great deal of war-flying experience.

From these figures it will be seen that the actual flying comparison between the heavier and lighter-than-air types is overwhelmingly in favour of the latter, except in the matter of speed, in which the aeroplane shows a marked superiority. In cruising endurance, disposable lift, efficiency ratio and static ceiling the airship of the German L. 70 type is enormously ahead of the D.H. 10A, which is the machine selected for comparison, and if the matter ended there it would only be possible to return one verdict in the matter of which type must prove best for commercial purposes. But so far from the question ending with these comparisons, it only begins there, and there are many other factors which cannot be given a place in such a non-controversial document as the "Notes." There is the question of comparative first cost and of upkeep to be considered, particularly when we come to the larger types of rigid airship. A capital outlay of £300,000 on the ship alone does not strike one as being particularly commercial when we find that all we get for the money is a cargo capacity of 170 tons. Against that we have to remember that for a similar cargo capacity by aeroplane we might have to incur very nearly as great an outlay, without the undoubtedly great advantages of wide radius of action of the rigid. Again, there comes the question of the comparative airworthiness of the two types. It is reasonably certain that the aeroplane can fly in weather in which it would be impossible to bring a rigid airship out of its shed. These are all questions, however—and there are many others—which it is scarcely opportune to argue now. Nothing more need be said than that the "Notes" are likely to be of the greatest interest and utility to those who are busy on plans of development. They contain a great deal of useful food for thought, and are in themselves a justification of the uses of the airship.

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General Seely and the Aerial Future

General Seely's speech at the dinner of the Imperial Air Fleet Committee last week arouses rather mixed feelings in our mind. His ideals of the future are admirable, and are completely in line with what we have written during the past few weeks on the R.A.F. and the Air Ministry during the post-bellum period. "We shall have to have Air Forces for military purposes still. People say to me, 'You must have an Air Force equivalent to the land and sea forces.' I say, 'Yes, but it would be wise to have an even greater proportion of Air Force.'" That is exactly the kind of talk we like to hear from the responsible head of the Air Ministry, and we are absolutely in accord with the views expressed. But, and this is where the shoe pinches, General Seely is after all only Under-Secretary of State for the Air, and is subordinate, nominally at least, to the Secretary of State for War. We have very little doubt that so long as Mr. Churchill is at the War Office he will back the opinions expressed by General Seely, but there is no guarantee that in six months' time and before our aerial policy is settled beyond revocation there may not be another Lord Haldane at Whitehall, who will set vigorously to work to undo all that may have been done by his predecessor in office and with whom a Minister like General Seely would find it impossible to work. Naturally, we are very greatly relieved to know that an official is at the helm of the Ministry, holding the long view of our aerial future, but we are still most strongly of opinion that the existing duality of office is highly detrimental to the public interest. Clearly, General Seely himself is determined that the Air Service is to develop along the natural lines mapped out for it by the course of events, but the trouble is that it is not he, but the Secretary of State for War, who has the ultimate decision in matters of policy and to whom Parliament will look in the last resort for guidance. So much for that aspect of the matter.

Proceeding, General Seely told his audience that he could promise them on behalf of the Secretary of State and for the Air Council that every effort will be made to help forward the air traffic of the future. Plans have been made in the most liberal detail for helping forward that traffic. Among the things we must do and can do is to secure great air routes to all the great Dominions of the Crown. In this effort to increase air traffic throughout the world, for the good of the world at large, we mean to secure the first place in a generous rivalry. We have great advantages. We have built up an aircraft industry which, with all due deference to our Allies, is the best and most scientific in the world. At present we navigate the air like sailors sailing over an uncharted sea. The science of meteorology is almost in its infancy, and the possibilities of marking air routes have only begun to be faced. But the plans, the brains, and the energy are there, and the money, he believed, would be forthcoming. From the victory we have won in the War we must go forward to another victory—the mastery of the air in the interests of the Empire and the whole of mankind.

This is all good hearing, and again gives us to marvel why on earth, if the Air Ministry and the R.A.F. are in fact to remain independent and separate from the other great Departments of State, Mr. Lloyd George has taken the extraordinary action he has, instead of appointing General Seely to be Secretary of State. Not only would such a course have been, we are convinced, in the best interests of the Air Service, but it would have avoided a great deal of the suspicion with which the public, and particularly that section which is specifically interested in aviation, regards official assurances regarding the future.

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What Does it all Mean?

We have said that people regard official assurances that the future of the Air Service is to be an assured one—that it is intended to develop it on precisely the lines that its most ardent well-wishers

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The Aircraft Engineer

Flight—And the Men

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Major-General Sir W. S. BRANCKER, K.C.B., A.F.C., until recently Master-General of Personnel, Air Ministry.

could desire. But against that we have the fact that the authorities appear to be playing fast and loose with the *personnel* of the R.A.F. We should like to ask the question whether any single officer of the Force, with the exception of those who initially joined the R.F.C. as "regulars" or those who came over to the R.N.A.S. from the Royal Navy, knows what the future holds for him if he takes a permanent commission? We are given to understand that no fewer than three separate letters have been sent to officers during the past few weeks, asking them to make the Service their career, but in none of them has any definite statement been made as to the terms of their new engagement. Instead they are told in effect that "you cannot be guaranteed your present rank, or any particular rank, while it is possible that you will not receive pay and pension at the present rates." Now, it is perfectly clear that there are many officers serving in temporary ranks who cannot be continued in the Service in those ranks. If they elect to remain on they must be content to accept a grade lower, or sometimes even two steps lower, than the rank they have held during the closing phase of the War. Also, it is possible, though we do not see why at the moment, that financial considerations will render it impossible to continue the present rates of pay. For our own part, we should be very reluctant to interfere with the pay warrant of the R.A.F., for the reason that if the country wants the best possible officers it must make the Service at least nearly as tempting as civil employment. If it decides that it cannot afford to pay for the best, then it will necessarily get only the second or third best, and the Service will be at a disadvantage as compared with the civil employer. But whatever decisions may be taken in this matter of rank and pay, they should surely be announced at once. The position now is that many good officers, who would like to remain in the R.A.F., are torn between the uncertainty of the future in the Service and the necessity of being early in the field for good positions in civil life. Many of them would willingly consent to sacrifice their temporary rank to remain, but they are not told what the Air Ministry has to offer them, and the Service is, therefore, in danger of losing large numbers of its best officers because the authorities are once more unable to make up their minds. This is really a deplorable state of things, and General Seely, who appears to be wholeheartedly in the movement for a powerful air service, might do a great deal worse than give this urgent matter his personal attention. To the officers who are hanging between two opinions we might offer the advice to defer decision for a few weeks longer until Parliament meets. Almost the first business that will come up for consideration is in connection with aerial matters, and it may be that the Air Ministry will take the opportunity of declaring its intentions and of asking for Parliamentary sanction. In any case, the matter is one of urgency, and should be settled at the earliest possible moment.

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British Brains in the War

There are some things that are done better in other countries than they are done here. On the other hand, there are very many that are much better done by ourselves than by others, and, although the pose of the period is that of a disbelief in the ability of our own people to invent or inaugurate, the lessons of the War do not by any means bear out the justness of that attitude. We have, not altogether, we think, without a certain amount of reluctance, taken credit to ourselves for having made the greatest amount of progress in aviation and in aircraft design. As we have really screwed ourselves up to the claim, it is reasonably certain that the amount of progress made by our scientists and designers is much greater than is at present known to the man in the street. That is really the case, and it is only by degrees that the well-kept secrets of the War are being allowed to partially leak out. For example, it has been thought by the uninitiated that it was America who gave us aerial wireless telephony, and that it was in America that it was perfected, and placed at the Allied disposal. Quite the contrary is the case, inasmuch as this was primarily a British discovery and was perfected through British research, though a good deal of assistance was given by France and America. It was in use in France before the end of 1917, and so highly was the secret prized that our pilots were given the most emphatic orders to at once destroy the apparatus in the event of their being compelled to make a forced landing behind the enemy's lines, and that the Germans never succeeded in fathoming the secret is earnest of the manner in which these orders were carried out. It is doubtful, however, if the apparatus would have told the enemy very much about the idea in any case. The range over which conversation can be conducted is about a dozen miles, and there is a case on record of one of our airship on patrol over the North Sea being informed by wireless telephone, at a distance of about ten miles, that 30 ft. of the upper keel had carried away and threatened disaster to the ship and crew. As it was, she was able to get back to her station in safety, thanks to wireless telephony.

As to our manner of doing things better than some of the rest, the aeronautical correspondent of the *Telegraph* reminds us that the German certainly, for all their painstaking thoroughness, had a habit of falling short in a number of ways. For instance, as he records, the Junker two-seater "trench-strafer" had two machine guns pointing straight down through the bottom of the *fuselage*. The natural effect of this was that its fire was rendered almost totally ineffective. Any sensible designer would obviously mount the guns to fire almost in the line of flight, in order to bring to bear a raking fire down a trench or along a body of troops or line of transport. We did not fall into *that* error, whatever else we may have done wrongly. This may in itself be quite a minor matter, but it is indicative of the fact that not all the mistakes were on our side. As a matter of fact, we have little to be ashamed of in the matter of enterprise and discovery, and much that should induce a feeling of pride in the resource and inventiveness of our own people. We are accustomed to talk of ourselves as though we were the prize fools of the earth, and there is very little doubt that the Germans took us at our own apparent valuation, which, on the whole, was perhaps not a bad thing as matters turned out. They probably know better now, and so, we imagine, do others. The veil of self-depreciation has been torn asunder, and the world has discovered that the British Empire is still in the forefront of scientific research and adaptability to sudden circumstances.

FLIGHT

Meteorology and Aerial Services

Recently *The Times* inaugurated a new and remarkable feature by the publication of aerial meteorological records, to which we drew passing attention last week. It is undoubtedly a landmark in journalistic enterprise, and *The Times* deserves unstinted credit for the departure, particularly because of the manner in which it directs attention to the pressing necessity for establishing a real State meteorological service. It is not a matter that should or can be left to private enterprise, which indeed we recently pointed out when drawing an analogy between the work of the State in relation to marine navigation and that which must be undertaken by the Government in connection with commercial aviation. This must be one of the very first tasks to be undertaken in the interests of aerial navigation in the future, since without such a service there can be no really far-reaching scheme any more than there could be marine navigation without harbours and coastal lights. We are quite aware that the matter is engaging attention, but the pity is that the State has once again been forestalled by private enterprise., True, the latter is on a relatively insignificant scale, but the basic fact remains that *The Times* has actually done something which the State should have carried out, especially as it has the war-created machinery of observation ready to its hand.

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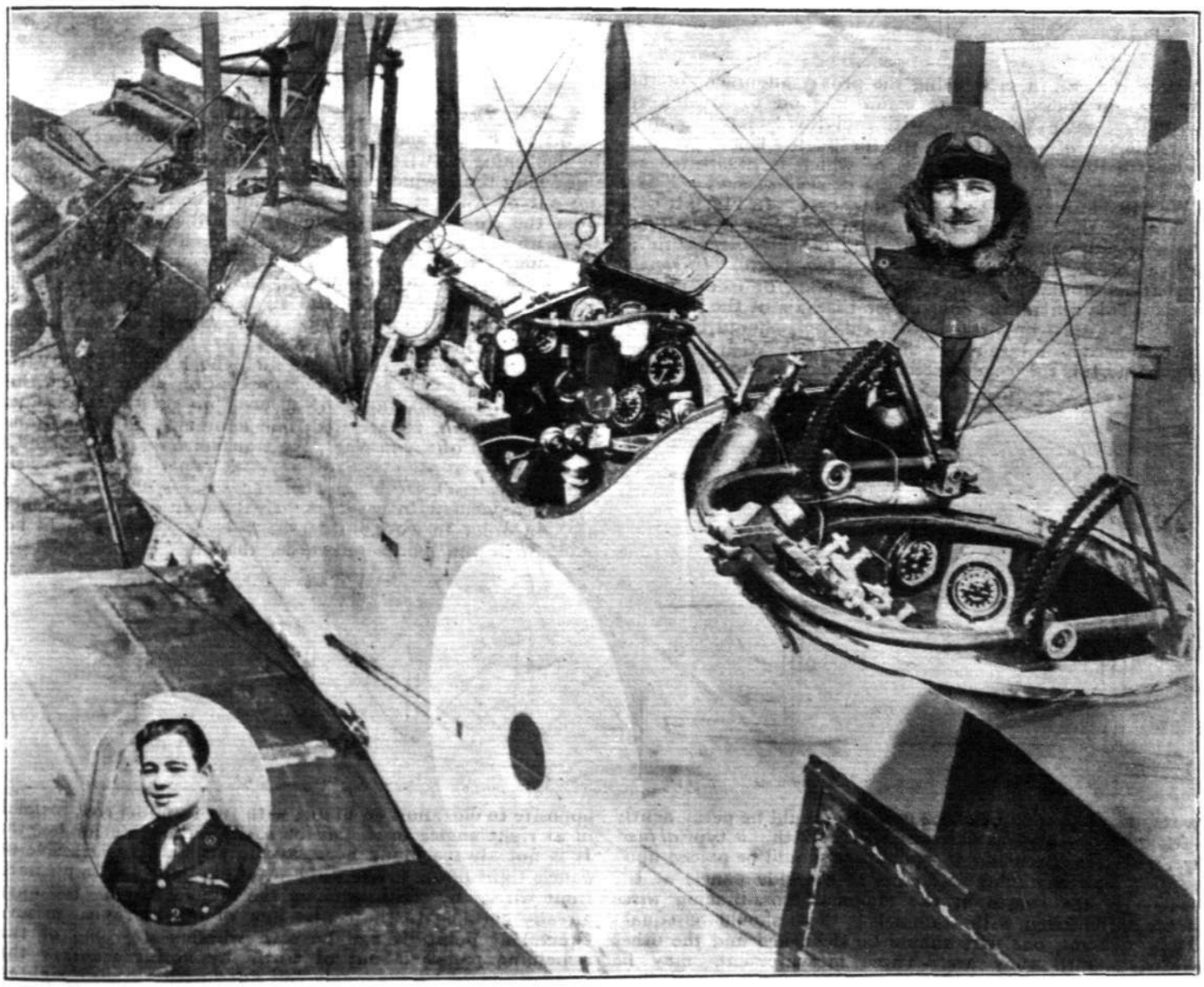
Age Limits in the R.A.F.

FROM regulations just issued by the Air Ministry to govern the granting of permanent commissions to those at present holding temporary commissions, it is evident that the R.A.F. is to remain a young man's service. For subalterns there is no minimum age, but the maximum is 27, and they will be compulsorily retired at 42. For captains there is no minimum, but if applications become too numerous, length of service in that rank will count rather than age; then maximum is 35 and they must leave at 45. For majors the minimum is 25, the maximum 38, and the retiring age 47. For lieut.-colonels the minimum is 30, the maximum 45 and the retiring age 53. For colonels the minimum is 35, the maximum 48, and the retiring age 57. In the case of those serving in the ranks of the Regular Forces previous to the war and who have since been granted commissions these limits need not be applied. Officers over 24 years of age must have had at least three and a half years service (commissioned or otherwise) during the present war. Those over 23 must have had three years service, those over 22, two years, those over 21 one year, while those under 21 will be specially considered by the Selection Board.

A Selection Board has been established by which all applications will be considered before submission to the Air Council. The Board will visit home and overseas stations to interview applicants. The members of the Board are as follows:—Brig.-Gen. T. I. Webb-Bowen, C.M.G., *Chairman*; Col. A. M. Longmore, D.S.O.; Lieut.-Col. W. D. Beatty; Lieut.-Col. F. S. Pilling; Major J. H. Tyler, M.B.E., *Secretary*.

It is not at present possible to state what scales of pay, pensions, and allowances will attach to permanent commissions in the R.A.F., but these will not necessarily be as good as the scales now in force.



The Pilot's and the Observer's cockpits on the D.H.9 machine with which on January 3 an altitude record of 30,500 ft. was put up at Martlesham by Capt. Lang, R.A.F., as pilot and Lieut. Blowes as observer, both of whom are inset. At the nose of the machine is seen the Napier "Lion" engine which enabled the height to be attained, whilst the many gauges and instruments installed on the pilot's dash and in the observer's cockpit form in themselves a useful study for the uninitiated.

RIGGING

THE ERECTION AND TRUEING-UP OF AEROPLANES

By F. W. HALLIWELL, A.M.I.A.E.

(*Continued from* **page** 107)

Fuselage

COMING to the actual manufacture of the machine, the most important component is the *fuselage*. The *longerons* will be shaped up and sized in the sawmill, probably on thicknessers and planers, and spindled if necessary, and with the various *fuselage* struts will arrive in the *fuselage* erecting shop all cut to size and ready for assembly. The sides are then put together in a box jig, which in its simplest form is a device consisting of a wooden base, with guides provided in which to lay the *langerons*, and g ides also at the properly spaced intervals in which to lay the inter-*longeron* struts. The *fuselage* fittings are slid along the *longerons* before they are placed in the jig, so that the whole can be wired up without removing it; the wires are then tightened up to approximately their initial tension. If a jig is not being used, it is important that the position of the strut sockets be accurately marked off, and that the two top and t v) bottom *longerons* be checked with regard to these positions, by laying them alongside one another, and noting that the position of the fittings corresponds exactly. The sides, and top and bottom, are now erected upon the bench and the *fuselage* "trued up." It will be remembered that "trueing-up" has been defined as the correct adjustment of the wire

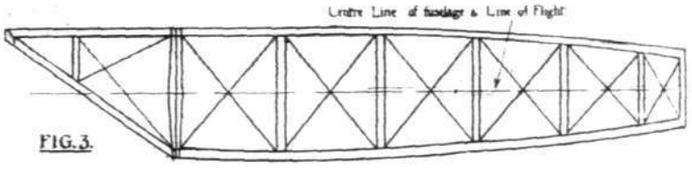


FIG. 3.

bracing, the end in view being the proper alignment of the structure in question. The exact method of trueing-up the *fuselage* varies somewhat with individual machines, but the majority of present-day tractor bodies belong to one of two distinct types, the first of which is illustrated in Fig. 3.

We will consider this type of *fuselage* first. In Fig. 3 it will be noticed that the top and bottom *longerons* are curved symmetrically about the centre line of the *fuselage* in a vertical plane, also the two top and two bottom *longerons* are curved similarly when viewed in plan, or from underneath. This centre line constitutes the axis of the *fuselage*, and it is of great importance that this axis should be true; it is also used as a datum line to work from. With this type of machine, it is the usual practice that each of the transverse

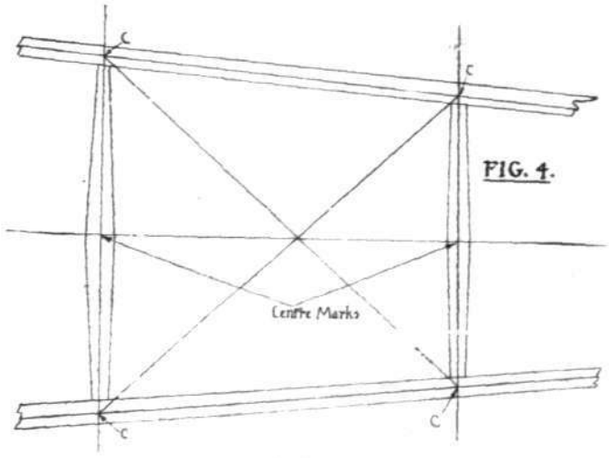


FIG. 4.

struts, on all four sides of the *fuselage*, should be permanently marked at its centre, as shown in Fig. 4. With his type of *fuselage*, when commencing to true up, it should be placed upo trestles, and beginning with one of the side panels at the front end, the length of the diagonal cross-bracing wires should be checked with trammels; these should be equal; if they are not, one wire should be slackened and the other tightened until they are. These measurements may be taken from the points of intersection of the centre lines of the *longerons* and struts (marked "C" in Fig. 4), or, if more convenient, from the centres of the holes in the wiring plates on the fittings, always assuming that these wiring plates project an equal amount from the junction of strut and *longeron*. It will almost invariably be found best to trammel from the points of intersection of the centre lines. Each panel should be so treated along the whole length of the *fuselage* on both sides. The alignment in the vertical plane can then be checked by stretching a line along the side of the *fuselage* from front to rear, which should coincide with the centre marks on each strut. The line should be tied directly to the centre mark on the forward strut, and at the rear end, where the *fuselage* tapers to the sternpost, a straight-edge should be clamped across a pair of struts near to the sternpost, level with both their centre marks, and the end of the line made fast to this. The line should now coincide with the centre marks all along the *fuselage*.

Where the struts at the rear end are some distance from the line, they can be checked approximately by sighting, but it is more accurate to square off from the struts to the line, or, if the struts are tapered, to square off from a straight-edge placed across the top and bottom *longerons*—see Fig. 5.

If by this check any one of the centre marks is found to

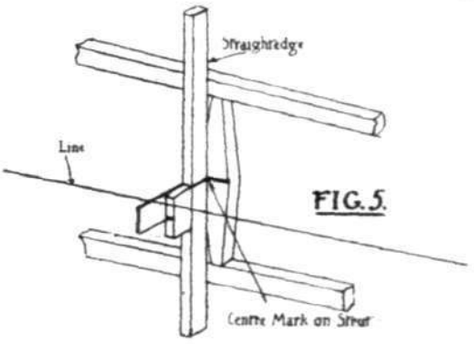


FIG. 5.

be off the line, it should be pulled up to its correct position by slackening the wires which come to one end of the strut, and tightening those which come to the other. If several panels are out of truth it will be found more convenient to work from the front end as previously described. After having trued up the sides in this manner, the top and bottom should be similarly treated. Care should be taken, before adjusting any panel which is out of truth, that the transverse cross-bracing, which gives torsional rigidity, is sufficiently slack to allow of the adjustment being made without overstraining. This alignment of the centre marks to the centre line from front to rear, may be taken as a final check for trueness with *fuselages* of this type. The next operation is to adjust the transverse cross-bracing wires in order to get the sides, and top and bottom, square with one another. Starting from the front end of the *fuselage*, the transverse diagonals should be checked against one another, each panel in turn, to see that both wires are the same length.

It is convenient to use a slightly different form of trammel here, in order to work inside the *fuselage*. They should be made with the points outwards, that is pointing exactly

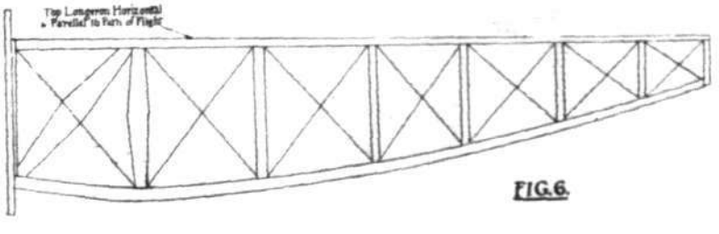


FIG. 6.

opposite to one another, in line with the trammel rod, instead of at right angles to it, and be easily adjustable for length. It is not always found necessary to adjust these transverse panels right down to the tail; after checking the immediate front wires, by sighting along the intersection of the ones already checked to the centre line of the sternpost or any equivalent point, it can be seen whether any one of the remaining panels is out of truth by noting whether the intersection of its diagonals coincides with the line sighted along. If the *fuselage* is square all the way along, all the diagonals will intersect along the line of sight. Fig. 6 shows the second of the two types of tractor *fuselages*. The main characteristic of this type of *fuselage* is that the top *longeron*

is absolutely straight in a horizontal plane, and forms a datum line to work from. It is also generally parallel to the path of flight. Therefore it is not necessary to set up a centre line to check the alignment of the side panels. If the top *longeron* is absolutely horizontal, the side panels are true, and if a long straightedge is available all that is required is to place it on each top *longeron* in turn, and note if it is true. Any portion that is out of truth should be pulled into place by slacking off one wire and, if necessary, tightening another. If a straightedge is not available, a line should be stretched along the *fuselage* just above the top of the *longeron*, and made fast to any handy bolt or fitting upon the machine, at front and rear. This will indicate any portion of the rail which is not true. After checking the side panels in this manner, the top and bottom of the *fuselage* should be trued up to a centre line in just the same way as for the type previously described. The transverse wiring can then be checked for squareness with sliding trammels. The whole *fuselage* may now be considered true in every direction, but it is wisest to finally check the position of the wing spar sockets, as if these are not correctly positioned there will be an initial error when erecting the wings. The vertical distance from the top *longeron* to the centre of the wing spar sockets should be the same on both sides; if the correct dimension is known either from the drawing or maker's specification, it should be checked to this. Their position lengthways along the *fuselage* should also be checked; the horizontal distance along the top *longeron* (in the case of a *fuselage* of the second type) to either the front or rear centre section strut sockets being checked to a known dimension, or else against one another. A final check for lengthways position is to square a line up from the centre of the spar socket to the top *longeron*, and mark the intersection of this line with the centre line of the *longerons* (in plan view), and measure with a line, or, better still, a steel tape, from these points to the sternpost. The distance should be equal in each case. An alternative method of erecting and trueing a *fuselage* of the second type, that is with top *longerons* horizontal, is first to assemble the top and bottom of the *fuselage* separately; in a factory this would be done in a jig as previously described for the sides; and true up by means of trammels. Then erect the sides into the top and bottom, the struts being already cut to dead length and angle, and set the *fuselage* up to flying level.

The side panels should then be adjusted until each strut is dead vertical; this can easily be checked with plumb lines, and when correct a datum line should be scribed on each strut at the height of the thrust line, that is the centre line of the propeller; this datum line will be a given distance from the top *longeron*, and will be the same for every strut on both sides of the *fuselage*. There are other types of tractor machines in which neither the thrust line nor the top *longeron* nor the centre line of the *fuselage* are parallel to flying level. Also in some cases the *fuselage* may be built up in two halves, front and rear. In such cases it will generally be found advantageous to approximately true up each half and erect together for the final trueing. If we consider a type to which both the above qualifications apply, it should be erected, with the halves together for the final trueing, as stated, preferably on a special jig, and set to flying level by working back from the incidence given by the bottom wing spar sockets. Then the *longerons* should be checked for angle to the drawing, and the vertical distance above any given datum line checked at various points on the *fuselage*, such as the front end of engine bearers, sternpost, etc. If the joint of the two halves is made by a fitting constituting a socket on one side of the joint, fitting the end of the *longeron* on the other, and bolting through, these holes should not be drilled until both halves are adjusted into correct alignment with one another. This drilling can always be left until after the final check, as the bracing wires will hold the halves in position while trueing. If the wire bracing in any of the panels is replaced by three ply, this should not be attached until the *fuselage* is true. In general it will be found that the procedure in erecting and trueing a *fuselage*, can be varied considerably for individual types, and that in many cases some of the operations described in the foregoing will not be necessary; especially does this apply when erecting machines in a factory. In all trueing operations, it is of great importance, when adjusting the wires, not to overstrain them. When a *fuselage* is finished and true, the tension in all the wires in the structure should be uniform. Too much initial tension may cause a wire to be overloaded when in flight, and in any case it is throwing a bigger stress than was calculated for upon the compression member. When adjusting a panel, one diagonal should always be slackened off before the other is tightened, and should it be necessary to tighten several wires and slacken the adjacent ones, the slacking off should always be carried out first. These rules apply equally to the trueing of any other unit. The *fuselage* being true, the undercarriage should now be fitted. Before erecting the undercarriage, it is necessary to see that each strut will fit well home in its socket, in order to make sure that when it is erected, the struts are bedded down, so that the load does not come on the bolts. They should also be checked

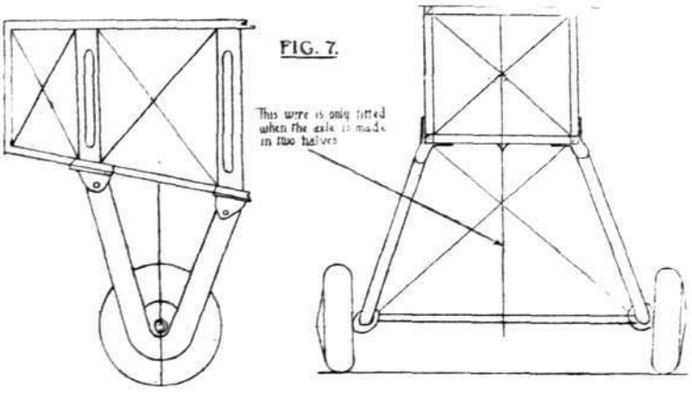


FIG. 7.

either to drawing or against one another for length. The type of undercarriage in most general use at present, known as the Vee type, consists of four struts, the front pair being diagonally braced by two streamlined wires. (This is shown in Fig. 7.) After the above precautions have been taken, this type can be lifted into place complete, and the cross-bracing wires trammelled up. If the struts are the right length, and the sockets on the *fuselage* in correct position, the undercarriage must be true. If, however, a further check is desired, a line, or tape, should be run from the centre line of the axle at each end, to the sternpost, and the lengths checked against one another. If the undercarriage is a type to which a skid or skids, are fitted, it is important that the angle at which they are inclined to flying level is correct, and, in the case of one, that it is truly central and parallel with the *fuselage* centre line, or in the case of two, that they are symmetrical about the centre line of the *fuselage*. This should be checked by plumb lines. After the undercarriage is fitted and trued, the machine is ready for the installation of the engine, petrol and oil tanks, etc.

If the engine is a stationary one, the trueness of the engine bearers, or feet, should be checked by setting up the machine to flying position, and trying them with a spirit level, both longitudinally and transversely; in the special case of machines whose engine centre line is not level, the bearers should be checked for the correct angle by a straightedge cut to this angle, used in conjunction with a spirit level. In the case of a rotary engine, the correct alignment in a vertical plane is secured, by accurately positioning the transverse girder which runs across the *fuselage*, and secures the rear end of the crankshaft. Any engine can be adjusted to its correct position in a horizontal plane by dropping a plumb line from each end of the crankshaft, and from the sternpost, and sighting along them. When all three are in line the engine is true. Care should always be taken, when using the sternpost as the datum point, that the last bays of the *fuselage*, top and bottom, are true.

In many types of machines these bays are very prone to get out of truth. The petrol tanks, together with the petrol and pressure systems, can now be installed, and the engine controls fitted. In most cases it will be found advisable to fit all the instruments to the dashboard before erecting it in the machine. The best procedure for fitting the many

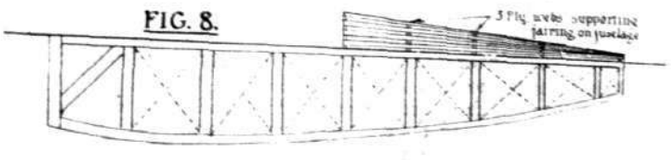


FIG. 8.

and varied minor parts to the *fuselage* can only be determined by experience, for each individual type of machine. The *fuselage* fairing, either for top, or sides, or both, is generally fitted at this stage. The function of this fairing, which consists generally of a number of wooden stringers supported at intervals along the *fuselage* by shaped three-ply webs, is simply to give streamline shape to the body, and it is usually constructed complete and glued up, on a jig, which correctly positions the various webs; and lifted on to the *fuselage* when ready, and secured, sometimes by small tacks, and sometimes

by glue. Fig. 8 shows a typical fairing for the top of a tractor *fuselage*.

When the *fuselage* is complete it should be looked over to see that all turnbuckles and nuts are properly locked, and then sent to the fabric shop for covering, and doping. All

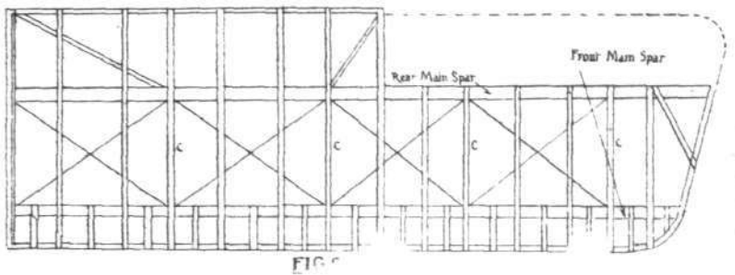


FIG. 9.

nuts should be locked with split pins, and turnbuckles with a keep wire passing through the hole in the barrel and both eyebolts, and twisted so that any tendency to unscrew on the part of the barrel, tends to tighten the keep wire.

Wings

It is necessary to true up each wing separately before they are covered and erected, in a similar manner to the *fuselage* but it is a very much simpler job. Fig. 9 shows the usual form of wing construction, in which the front and rear spars are parallel. These spars come from the mill already finished to size, and length, and spindled out, leaving the portions where the compression ribs (marked "C" in the Fig.) occur solid. Both these compression ribs, and the lighter former ribs, are built up separately, and threaded along the spars, the whole being laid in a jig which positions each rib correctly. The wires can then be put in and tightened up to approximately their initial tension. If the wing is not assembled in a jig, care should be taken to check the position of the fittings for the compression ribs and interspar struts, by laying the spars alongside one another and noting that these coincide exactly. The position of the former ribs should be marked off on one spar, and the other one marked from it, as it is important that these be put on exactly at right angles to the direction of flight. The plane should then be laid on a pair of trestles, care being taken that it is resting upon the main spars, preferably at the junction of a compression rib, and not upon the leading or trailing edges, or former ribs, which are very light, and easily deformed. Commencing from the inside end of the wing, each bay can now be trammelled up, the diagonal wiring being adjusted until the bay is true, in the manner previously described for the *fuselage* panels. When every bay is true, the whole wing structure should be true. It is advisable, however, to sight along the leading and trailing edges, in order to make sure that they are not bent, or in any way out of line. A final test for the alignment of each wing after trueing, is to test each spar separately, either with a long straightedge along the top and side, or by stretching a line along the length of the spar, just clear of one corner, and noticing whether the corner edge runs parallel with the line. The procedure for trueing-up the tail plane and elevators, where these members are wire-braced, is exactly similar; except that as the tail plane is usually in one piece symmetrical about its centre, the centre bay should be trammelled up, and adjusted first, then each bay in turn, working outwards on either side alternatively. It is equally important with the wings and tail plane, or indeed any unit, to go over the whole, and see that all turnbuckles and nuts are securely locked, before it is passed on to the fabric shop.

Covering

All the component parts of the machine having been trued, and everything locked, they are ready for covering with fabric and doping. There are two methods in use of fixing the fabric on to the wings, the first is by sewing it on to the ribs, and the second by fixing it to each rib by a cane strip, which is screwed down to the rib by brass screws. The former is in most general favour. With this method the twine should always be waxed before use. The fabric should be sewn together so that the seams will run parallel to the direction of flight, these joints should be of the balloon seam type, and double stitched. The fabric should be laid over the leading edge, and the edges drawn up and sewn along the trailing edge. When sewing it down to the ribs, the pitch of the stitch should be about 4 in., or less in the case of the small wings; and about every three stitches the twine should be double knotted, so that, should it break, it only becomes loose in that section, and not all along the rib. Before putting the fabric on to the wings or any other parts, the woodwork should be shellaced, and the metal parts painted over with dope-resisting paint. After sewing down the fabric to the ribs, the stitches should be covered by a strip of Egyptian tape, well frayed at the edges, and doped on. A similar strip should also be doped on along the leading and trailing edges of the wing.

When all parts are covered, they receive four or five coats of dope, each successive coat being allowed to dry, before putting on the next. The number of coats and the mixing of the dope is best carried out according to the manufacturer's instructions for any particular brand. When the last coat of dope is dry, the upper surface is generally given a coat or two of pigment varnish, and the under surface a coat or two of transparent varnish.

(To be concluded.)

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From Belfast to Sheffield

THE following note was issued by the Press Bureau on January 24, six days after the event :—

On Saturday, the 18th inst., a Handley-Page aeroplane, fitted with four 350-h.p. Rolls-Royce engines, flew from Belfast to Sheffield. The total weight on board was 12 tons, including a crew of seven and half a ton of luggage. The time taken by the flight was 2 hours 35 minutes.

The Ipswich to India Flight

A TELEGRAM from *The Times* correspondent at Karachi on January 13, announced that the Gen. Mc.Ewen's machine had left Bander Abbas at the entrance to the Persian Gulf at 8.55 a.m. and passed over Charbar, 350 miles distant, at 1.25. At 4 p.m. the machine was compelled to land at Ormara on the Baluchi coast. Some days later the journey was resumed, and the 150 miles to Karachi was covered in about two and a half hours.

From later information it appears that on December 30, when the machine was about 3 miles out to sea, off Ormara, one cylinder of the port propelling engine blew off and the aeroplane was forced to land near the beach. By discarding all spare parts, kit and wireless the pilots, Major A. S. MacLaren and Capt. Halley, with one mechanic, decided to try and complete the journey with the remaining three engines. Two of these engines were put out of commission soon after the restart owing to the vanes coming off the windmills driving the petrol pressure pumps, but this was rectified by hand pumping. Thirty-five miles from Karachi the rear starboard engine stopped, owing to the breaking of one of the oil leads, but with difficulty, the machine was able to reach Karachi.

General McEwen and two mechanics completed their journey on H.M.S. "Britomart."

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An Italian Speed Record

ACCORDING to *The Times* correspondent at Rome, a new Italian biplane, piloted by Sergeant Elia Lint, has given under its official trials an average certified speed of 266.8 kilometres (162 miles) per hour. The trials were conducted at a height of 30 metres (nearly 32 yards) from the ground, so as to control the "flatness" of the flight; and flights were made both with and against the wind. The motor was 200 h.p. of the S.P.A. type used in Signor D'Annunzio's flight to Vienna. It is claimed that the average speed attained exceeded by 30 kilometres (18½ miles) the previous record under similar conditions.

Across the Mediterranean

IN spite of bad weather, Lieut. Roget, with Capt. Cole, in a military biplane, fitted with a 300 h.p. engine, succeeded in flying across the Mediterranean from Marseilles to Algiers on January 26. They started from Istres in the Bouches-du-Rhone at 2 a.m., and landed at Algiers five hours later. After a rest of about an hour they set off on the 500 mile journey back to France, but were forced to land at 7 p.m. at Rosas in Catalonia, having lost their way in the mistral, and flown for about 1,000 miles over the Mediterranean, which they crossed twice.

No Zepps. in Jutland Battle

A ZEPPELIN officer discussing the Jutland Battle with a member of the Allied Naval Commission in German waters said it was not true that they had Zeppelin reconnaissance on May 31, the day of the battle. "The High Sea Fleet," he went on, "would never have allowed itself to be drawn into action with your Battle Fleet if we had had aerial observation to tell us how near they were. We *planned* to have Zeppelins out on that day, but the weather was not favourable. We *did* have them the day after the battle, but they were of not much use then."

FLIGHT

HONOURS

Honours for Mesopotamia

IT was announced in a supplement to the *London Gazette* on January 11 that the King has been pleased to approve of the following awards to the following officers in recognition of their gallantry and devotion to duty in the field :—

Bar to the Military Cross

Lieut. A. H. E. Lindop, M.C., I.A.R.O., attd. 37th Dogras, now attd. R.A.F. (Mesopotamia).—For conspicuous gallantry and devotion to duty. He forded a river, passed through the enemy picquet line, and brought back most valuable information. On a previous occasion he reconnoitred the sluice at the head of the river, although fired on continuously. (M.C. gazetted Aug. 25, 1917.)

Military Cross.

Lieut. J. O. Allison, West Ont. R., secd. to R.A.F. (Mesopotamia).—For conspicuous gallantry and devotion to duty. Often he descended to within a few hundred feet of the ground and, regardless of danger, bombed and machine-gunned the enemy. On one occasion he carried out four bombing raids in one day at low altitudes.

Capt. J. Everidge, Surrey Yeo. and R.A.F. (Mesopotamia).—For conspicuous gallantry and devotion to duty. He performed bold and daring work on reconnaissance, artillery co-operation, and contact patrol, and also carried out many successful bombing raids by day and night. He rendered excellent service.

Temp. Lieut. R. K. Morris, Durham L.I. and R.A.F. (Mesopotamia).—For conspicuous gallantry and devotion to duty. He fought a number of battles in the air with great skill and daring, and on one occasion brought down an enemy machine behind our lines.

Capt. L. W. Shelly, R.A.M.C., attd. No. 1 Aeroplane Supp. Depôt, R.A.F.—For conspicuous gallantry and devotion to duty. When this depôt was heavily bombed in a night raid he organised a dressing station at the repair park, attending the wounded in the open. Several bombs fell close to him, wounding those around him, but he stuck to his work and saved the lives of many by his coolness and courage.

Temp. Lieut. R. B. B. Siever, R.F.A. and R.A.F. (Mesopotamia).—For conspicuous gallantry and devotion to duty. He carried out particularly difficult artillery co-operation with great success, displaying skill and coolness. On one occasion, when flying at night, after having landed behind the enemy's lines in flames, he got back 24 miles into his own lines, carrying a Lewis gun.

Lieut. A. E. L. Skinner, Norfolk Yeo. and R.A.F. (Mesopotamia).—For conspicuous gallantry and devotion to duty. He carried out many long-distance reconnaissances alone, bringing back most valuable information. He fought many battles in the air, and succeeded in bringing down an enemy machine behind our lines. He did fine work.

"Mentioned" for Work in Egypt.

IN the list of names mentioned in dispatch of Genl. Sir E. H. N. Allenby, G.C.B., G.C.M.G., Commander-in-Chief Egyptian Expeditionary Force, for services during the period from March 16, 1918, to September 18, 1918, are the following :—

Royal Air Force

Lieut. D. Alliban (N. and Derby R. (T.F.); Capt. (A. Maj.) A. J. G. Anderson ; Capt. (A. Maj.) L. J. Bayly, M.C. ; Lieut. J. Beattie; Maj. V. A. Beaufort, M.C. (Devon R.) ; Capt. (A. Maj.) W. L. Birch, M.B.E. (W. York. R.) ; Sec. Lieut. (Hon. and A. Lieut.) D. G. Bourn ; Lieut.-Col. C. Bovill ; Lieut. P. R. Bowen, M.C. ; Lieut.-Col. H. le M. Brock, D.S.O. (R. War. R.); Lieut.-Col. C. S. Burnett, D.S.O. (R. of O.) ; Lieut. J. E. Carpenter ; Maj. A. G. H. Carr ; Lieut. O. W. Clapp ; Lieut. H. R. P. Collett ; Lieut. and Hon. Capt. H. A. Courtenay (R.A.S.C.) ; Capt. G. R. A. Deacon, M.C. ; Capt. W. H. Dolphin ; Lieut. W. Elliott (R.A.S.C.) ; Capt. E. C. Emmett, M.C. ; Sec. Lieut. G. F. Felstead, D.C.M. ; Capt. J. McG. Glen, M.C. (R. Scots) ; Maj. N. M. Halcombe (Lieut., R.E., T.F.) ; Lieut. C. M. Hallett ; Sec. Lieut. D. A. Harding ; Lieut. B. R. Harris (R.F.A., T.F.) ; Lieut.-Col. (A. Brig.-Genl.) P. L. W. Herbert (N. and Derby. R.) ; Sec. Lieut. and Hon. Lieut. H. Hey ; Lieut. T. P. Isaac ; Capt. (A. Maj.) M. Keegan ; Lieut. R. H. Ley (B. Columbia R.) ; Capt. F. J. F. Lee (R. Mun. Fus.) ; Lieut. J. B. Low (H.L.I.) ; Capt. (A. Maj.) C. W. M. Ludgate ; Lieut. J. F. P. Maclaren (Ayr Yeo., T.F.) ; Lieut. (A. Capt.) A. D. Makins ; Maj. E. L. Millar, M.B.E. ; Lieut. (A. Capt.) G. B. Mutton (R.F.A., T.F.) ; Sec. Lieut. C. S. Noble ; Capt. R. A. Pierpoint ; Capt. L. P. H. Preston, M.C. (Gen. List) ; Lieut. R. W. Reeve (Hereford R., T.F.) ; Lieut. (A. Capt.) H. C. Roberts ; Lieut. and Hon. Maj. C. W. Rowe (Maj., Hunts. Cyc. Bn., T.F.) ; Lieut.-Col. R. E. M. Russell, D.S.O. ; Maj.-Genl. W. G. H. Salmond, D.S.O. (R.A.) ; Lieut. W. D. Scott ; Lieut. A. T. Shaw ; Lieut. W. B. Shelton ; Lieut. G. C. Shortridge (I.A.R.O.) ; Lieut. W. H. Smith ; Lieut. M. E. Staples (Can. F.A.) ; Lieut. (T. Capt.) J. H. Storey ; Lieut. (A. Capt.) R. B. Sutherland (Capt., Can. Engrs.) ; Maj. A. W. Tedder ; Capt. H. H. Thomas (Sec. Lieut., R.F.A., S.R.) Capt. C. C.; Treatt ; Sec. Lieut. (A. Lieut.) J. E. Tyrrell; Lieut. J. Webster, M.C. ; Sec. Lieut. H. Woffenden.

26047 Cpl. Mech. S. Aldis ; 78431 1st Air-Mech. P. P. Allen ; 403415 1st Class Clk. S. E. Ambrose ; 107782 1st Class Clk. A. Barber ; 8741 Cpl. Clk. J. Barlow ; 403980 Sgt.-Mech. F. Barrett ; 4038 Chief Mech. W. O. Batchelor ; 4970 Sgt.-Mech. C. Beeks ; 8075 1st Air-Mech. W. Bennison ; 19430 Flt. Clk. J. Bicknell ; 8893 Cpl. Mech. W. H. Brady ; 6432 Sgt. Mech. E. J. A. Burges ; 108669 1st Class Clk. J. W. Cantelo ; 3222 Cpl. Mech. (A. Sgt. Mech.) T. J. Carsons ; 21221 Flt. Clk. A. Casson ; 6737 Chief Mech. C. J. Catchpole ; 47100 1st Air-Mech. J. W. Chambers ; 24201 Sgt. Mech. S. P. Driver ; 45054 Cpl. Mech. P. J. Dupen ; 3630 Chief Mech. A. C. Eagers ; 403891 Chief Mech. T. Evans ; 403749 Chief Mech. C. E. Eveleigh ; 15325 Cpl. Mech. J. H. Ford ; 6235 Flt. Clk. W. H. Freethy ; 27661 Cpl. Mech. H. Gingell ; 27741 Cpl. Clk. S. Godfrey ; 7887 Sgt. W. O. Godfrey ; 403885 Cpl. Clk. A. S. Heffer ; 30967 Pte. 1st Class (A. Cpl.) C. F. Hudson ; 16048 Sgt. Mech. F. R. James ; 410048 S.M., 2nd Class J. M. Jones ; 3342 Sgt. Mech. S. Kershaw ; 403568 Cpl. Mech. A. Knight ; 403695 Chief Mech. A. Lambert ; 68121 Pte., 1st Class A. J. Leak ; 16755 Cpl. Clk. (A. Sgt.) E. F. Leak ; 408757 Sgt. Clk. D. F. Lee ; 403490 Sgt. Mech. H. Madeley ; 8033 1st Air-Mech. T. E. McQuarrie ; 49022 Cpl. Mech. W. B. Meayers ; 9383 Flt. Clk. J. Milner ; 403422 Cpl. Clk. A. E. G. Morgan ; 31401 Flt. Clk. J. Newcomb ; 403436 Sgt. Clk. D. C. Oliver ; 66566 Cpl. Mech. J. W. Phillips ; 6185 Sgt. Mech. J. L. Porter ; 33967 Chief Mech. T. Prescott ; 29443 Chief Mech. J. R. Reed ; 41488 Cpt. Mech. J. Richardson ; 28022 Sgt. Mech. R. S. Rundle ; 107964 Cpl. Clk. P. R. Shaw ; 3032 Chief Mech. W. Shaw ; 27080 Sgt. Mech. F. C. Sowden ; 68505 2nd Class Clk. E. G. Sparkes ; 23627 Sgt. Mech. H. J. Spencer ; 403942 Sgt. Mech. C. Stewart ; 7798 Cpl. Mech. R. J. A. Staide ; 23712 Flt. Clk. W. E. Sullivan ; 35862 1st Air-Mech. (A. Cpl. Mech.) G. E. Swan ; 2877 Sgt. Mech. H. Swindell ; 19353 Flt. Clk. W. O. Talbot ; 17950 Chief Mech. G. T. Taylor ; 6015 Chief Mech. W. Turner ; 11181 Flt. Clk. R. E. Turner ; 68015 Cpl. Clk. H. Van Der Veen ; 6285 Sgt. Mech. T. Vickerman ; 35005 Cpl. Clk. G. Williams ; 3761 Chief Mech. T. H. Williams ; 24194 Sgt. H. Wilson ; 30283 Chief Mech. G. H. Womersley ; 3346 Sgt. Clk. V. V. Woods.

"Mentioned" for Service in the Air Ministry.

IT was announced by the Air Ministry on January 22 that the following officers and other ranks of the Royal Air Force (including personnel, Women's Royal Air Force) have been brought to the notice of the Secretary of State in respect of the valuable services they have rendered in connection with the war, and a record to this effect will accordingly be made in the Official records :—

Sec. Lieut. A. J. Adams, Sec. Lieut. (A. Lieut.) F. Adams, Maj. G. G. Adeley, Lieut. (A. Capt.) W. Algie, D.S.O., Capt. T. Allen, Lieut. W. R. P. Allen, Administrator Mrs. L. B. Anderson, Capt. (Hon. Maj.) W. B. Armitage, Lieut. G. R. Ashton, Capt. (A. Maj.) O. M. Ayrton.

Maj. J. B. R. Bacchus (A.P.D.), Lieut. F. L. Baker, Sec. Lieut. (A. Lieut.) G. Baker, Capt. L. I. Barker, Capt. (A. Maj.) M. Bartlett (deceased), Capt. (A. Maj.) P. M. Beachcroft, Lieut. (A. Capt.) C. O. Bean, Lieut. (A. Capt.), W. Beaver, M.C., Capt. E. W. T. Beck, D.S.O., M.C., Col. (A. Brig.-Genl.) J. H. W. Becke, C.M.G., D.S.O. ; Capt. B. J. Beeton, Capt. (A. Maj.) C. H. Bell (S.O., S.E. Area) ; Sec. Lieut. (A. Capt.) G. M. Bell, Capt. A. Bell-Irving, M.C., Capt. C. B. Belt, M.C., D.C.M. (A. Lieut.-Col.) H. R. Bently, Capt. (A. Maj.) J. S. D. Berrington, Lieut. W. M. Bevan, Lieut. (A. Capt.) L. F. Beynon, Lieut. G. J. Blackmore (Canada), Lieut. (A. Capt.) H. S. Blakeley, Capt. (A. Lieut.-Col.) J. D. Blyth, Capt. A. Boor, Capt. (A. Maj.) R. G. Booth, Capt. (A. Maj.) J. J. Botterill (Washington), Lieut. E. W. Bowen, Lieut. J. S. Bowler (Canada), Maj. J. M. Boyd, Lieut.-Col. (A. Col.) E. F. Briggs, D.S.O., Lieut. F. Briggs, Sec. Lieut. H. G. Bright, Lieut. R. H. Bright, Sec. Lieut. (A. Capt.) F. R. Brighten, Sec. Lieut. (A. Capt.) F. G. Brockman, Capt. (A. Maj.) the Hon. G. St. J. Brodrick, M.C., Maj. R. V. C. Brook, Maj. (A. Lieut.-Col.) H. A. Browne, Capt. J. S. Browne, Capt. W. F. Bryant, Capt. V. F. P. Bryce (Washington), Lieut. (A. Capt.) H. S. Burdett, Lieut. (A. Capt.) H. C. Burdett, Lieut. T. R. R. Burns, Lieut. R. E. Butler.

Lieut. G. Cameron, Sec. Lieut. G. A. Campbell, Lieut.-Col. C. F. Campbell, C.I.E., Lieut.-Col. H. Campbell, D.S.O., Maj. W. C. Campbell, D.S.O., M.C., Capt. (A. Maj.) R. G. L. Candy, Capt. J. W. Cater, Adminr. Mrs. I. B. Carruthers, Lieut. H. Cassels (Canada), Capt. G. B. Chainey, Capt. (A. Maj.) W. A. Chauncy, Capt. C. K. Chandler, Capt. (A. Maj.) E. W. F. Cherry, Capt. G. M. Clarke, Capt. D. B. Cleghorn (Washington), Sec. Lieut. S. T. Clemens, Capt. S. W. Clift, Capt. W. H. Clover, Capt. (A. Maj.) L. C. Coates, Maj. H. Cockerell, Lieut. (A. Capt.) R. A. W. Collet, Maj. A. W. Colley, Lieut. (A. Capt.) K. D. G. Collier, Lieut. A. D. Collins, Capt. (A. Lieut.-Col.) L. B. Cook, Capt. (A. Maj.) C. B. Cooke, Capt. S. W. Cooper (Washington), Lieut. (A. Capt.) L. M. Copeland, Sec. Lieut. N. E. Corbishley, Maj. J. W. Cordingley, Lieut. J. C. Coulson, Maj. H. A. Cox, Lieut. (A. Capt.) R. C. Cox, Capt. (A. Maj.) A. Crook, Capt. (A. Maj.) W. M. Cumming, Maj. J. K. Curwen.

Lieut. J. H. Davis, Sec. Lieut. W. Daughton, Lieut. E. C. Davies, M.C., Lieut. (A. Capt.) I. M. Davies, Sec. Lieut. P. V. Davies, Capt. R. W. Dawes, Capt. J. F. A. Day, A.F.C., Lieut. C. M. Denny, Lieut.-Col. G. C. St. P. De Dombasle, Capt. J. C. Derham, Capt. (A. Maj.) G. W. Dobson, Maj. C. G. Docwra, Lieut. C. Donald, Capt. I. A. J. Duff, M.C., Lieut. B. N. Durant (Canada), Sec. Lieut. R. F. Durrant, Maj. J. F. Dyer.

Col. W. Elliot, C.B. (R.A.), Lieut. C. A. A. Eliot, Capt. W. H. Elliott, Maj. A. T. Evans, Capt. W. J. J. E. M. Everard.

Naval Instr. H. F. Farr (Washington), Sec. Lieut. (A. Lieut.) G. Feeny, Lieut. (A. Capt.) R. Ferguson (Washington), Maj. G. K. Field, Maj. H. F. Fisher (Canada), Sec. Lieut. (Hon. Lieut.) S. Fleming, Capt. A. W. Fletcher, A.F.C., Lieut.-Col. B. S. Foster, Sec. Lieut. (Hon. Lieut.) P. W. Fox.

Capt. (A. Maj.) C. J. Galpin, D.S.O., Lieut. P. J. Gardiner, Lieut. (A. Capt.) F. G. Garratt (Canada), Lieut. W. Gawkroger, Capt. W. G. Gledhill, Capt. (A. Maj.) D. Gordon, Maj. J. W. Gordon, Capt. O. H. Gotch, M.B., Lieut. (A. Capt.) A. Graham, Capt. B. Grant, Capt. H. B. Griffiths (Canada), Capt. A. G. Griggs, Lieut.-Col. E. H. Griffith, Lieut. A. W. Grigsby, Sec. Lieut. (A. Lieut.) W. H. M. Groom, Asst. Adminstr. Miss E. M. Grubb, Capt. L. J. Gulliver-Cradwick.

Lieut. (A. Capt.) E. D. Hall, Lieut. (A. Capt.) V. J. Hammond (Washington) ; Capt. (A. Maj.) W. A. Hannay (Washington), Capt. (A. Maj.) W. T. Hanson, Capt. L. G. Harber, Capt. B. E. Harrison, Sec. Lieut. C. W. Harrison, Lieut. (A. Maj.) R. A. Hassard, Lieut. H. R. Hastings, Lieut. (Hon. Capt.) (A. Maj.) G. H. A. Hawkins, Capt. F. H. Hawksford (Canada), Lieut. (A. Capt.) C. C. Hayward, Capt. W. Hayward, Maj. G. L. P. Henderson, M.C., Lieut. J. L. Henry, Lieut.-Col. V. Henry, C.B., Capt. L. Henchall, Maj. C. T. Hesketh, Lieut. A. G. Hewer, L.D.S., R.C.S., Sec. Lieut. T. A. Higgs, Capt. W. R. M. Hill, Lieut. D'A. F. Hilton, M.C. (Canada), Lieut. A. H. Hinton, Capt. O. Hook, Capt. A. R. Howard, Lieut. A. Hughes, Capt. G. F. Hughes, M.C., Maj. T. G. Hull, Capt. (A. Maj.) A. Hunter, Capt. P. B. Hunter, Lieut. C. A. Hyde.

Sec. Lieut. A. D. Jack, Maj. J. O. James, Maj. J. W. Jardine, Maj. (A. Lieut.-Col.) C. Jarrott, O.B.E., Sec. Lieut. G. V. Jennings, Sec. Lieut. (A. Lieut.) C. T. Johnson, Capt. R. Johnson, M.B., F.R.C.S. (R.A.M.C.), Capt. (A. Maj.) H. W. G. Jones, M.C., Capt. J. H. O. Jones, Lieut.-Col. L. Jenkins, D.S.O., M.C. (deceased).

Capt. (A. Hon. Maj.) G. W. C. Kaye, Maj. D. H. Kennedy, Sec. Lieut. (A. Capt.) J. Keyes, Lieut. C. King (deceased), Lieut. (A. Capt.), F. Knight, Maj. H. St. J. Knight, F.S.I. (Canada), Lieut. (A. Capt.) F. F. H. E. Kolligs.

Lieut. (A. Capt.) W. A. Landry (Canada), Lieut. A. Lanman, Lieut. G. F. Law, Sec. Lieut. A. Ledgerwood, Lieut.-Col. H. Lee, Capt. E. P. Leigh-Bennett, Capt. (A. Maj.) A. M. Lester, Capt. A. F. Livingstone, Sec. Lieut. H. L. Lobb, Lieut. T. Longman (Canada), Sec. Lieut. (Hon. Lieut.) J. J. Lovesay, Lieut. (Hon. Capt.) G. F. Lucas, Lieut. (A. Capt.) F. D. Lugard.

Capt. (A. Maj.) D. McBirney, Capt. (A. Maj.) L. L. MacLean, Capt. E. S. McDonald, Lieut.-Col. A. W. C. McFall, Sec. Lieut. F. D. McGuire, Lieut. A. McIntosh, Maj. F. V. H. Mackenzie, Capt. (A. Maj.) W. C. Mackey, Capt. A. J. McElroy (United States Army), Lieut. (A. Capt.) G. McPherson, M.C., Maj. O. C. Macpherson (Canada) ; Sec. Lieut. (Hon. Lieut.) (A. Capt.) F. McRae (Canada), Capt. E. L. Mann, Sec. Lieut. L. J. Marden, Maj. (A. Lieut.-Col.) R. G. L. Markham, Sec. Lieut. (A. Lieut.) W. Marshall, Lieut. A. (Capt.) J. A. P. Martin, Capt. C. Mason, Lieut. E. V. D. Mathews, Capt. J. T. Matthews, Capt. R. M. S. Maxwell, Sec. Lieut. (A. Capt.) R. G. Meech, Capt. L. S. Metford (Canada), Lieut. W. D. Miller, Capt. H. Milman, Lieut. (A. Capt.) C. J. Miln, Lieut. (Hon. Capt.) H. H. de B. Monk, M.C., Capt. (A. Maj.) C. H. Morgan, Lieut. (A. Capt.) P. H. Morrissey, Maj. E. F. Moyes, Capt. (A. Maj.) R. B. Munday, D.S.C., Lieut.-Col. (Hon. Col.) L. Munro.

Capt. (A. Maj.) A. A. Nathan, Maj. G. C. Neilson, Lieut. B. O. Newman, Capt. W. P. Nicholls, Surg.-Genl. Sir W. H. Norman, K.C.B., Lieut. (A. Capt.) J. D. D'A. Northwood, Maj. C. W. Nutting, D.S.C.

Lieut. G. S. O'Brien (Canada), Capt. T. J. Offer, Maj. P. Owen.

Lieut. (A. Capt.) L. G. Paling, M.C., Capt. (A. Maj.) W. Park, Maj. S. C. Parr (Canada), Capt. H. S. Parsons (Canada), Lieut. (Hon. Capt.) H. M. Parsons, Capt. C. R. M. Pattison, L.R.C.P., etc., Capt. (A. Maj.) L. G. S. Payne, M.C., Lieut. (A. Capt.) A. G. Peace, Maj. R. H. Peck, Capt. P. P. C. Penberthy, Lieut. P. Perfect, Maj. S. P. V. Phillips, Lieut.-Col. F. H. G. Playfair, Capt. C. R. E. Pope, Capt. (A. Maj.) H. S. Powell, M.C., Maj. O. H. Powell, Maj. G. D. Pryor.

Capt. (A. Maj.) G. Ralston, Capt. (A. Maj.) T. C. Rapp, M.C., Dpty. Adm.

Mrs. A. Rathbun, Dpty. Adm. Miss D. L. Reed, Capt. F. H. E. Reeve, Sec. Lieut. (Hon. Capt.) W. H. P. Rees, Lieut. (A. Capt.) J. S. Reid, Capt. (A. Maj.) J. E. Rendle, Capt. (A. Maj.) L. Reynolds, Sec. Lieut. W. J. Richards, Lieut. B. V. Richardson, (Canada), Lieut. W. Righton (deceased), Capt. A. I. Riley, Lieut.-Col. C. Macl. Robertson, Maj. (A. Lieut.-Col.) R. S. Robinson, Capt. T. A. B. Rolfe (Canada), Capt. (A. Hon. Maj.) A. A. Ross, Lieut. R. N. Rowell, Maj. (A. Lieut.-Col.) R. W. Roylance, Sec. Lieut. P. T. Rule, Sec. Lieut. E. H. Rundle, Lieut. J. G. Ryrie (Canada).

Capt. R. J. Sanceau, Capt. H. L. Satchell, Sec. Lieut. H. Satterford, Maj. E. S. Saunders, Sec. Lieut. J. L. Saxton, Capt. J. H. Scandrett, M.C. (Canada), Capt. W. L. Scandrett (Canada), Sec. Lieut. (A. Capt.) W. J. Scott, Capt. R. D. Seddon, Capt. (A. Maj.) H. O'N. de H. Segrave (Washington), Capt. (A. Maj.) E. Selby, Lieut. (A. Capt.) C. M. Seth-Ward, Capt. M. A. Seymour (Canada), Capt. (A. Maj.) F. C. O. Shaw, Lieut. (A. Capt.) W. J. R. Sheppard (Washington), Capt. H. Sherwood, Sec. Lieut. W. J. Shilcott, D.S.M., Capt. F. A. Short, Capt. A. E. Siddons-Wilson, Lieut. (A. Maj.) P. C. Simmons, Capt. T. G. Skeats, Capt. P. W. Smith, Lieut. (A.) Capt.) R. N. Smith, Capt. H. Spink, Lieut. (A. Capt.) W. W. Stainer, Lieut. T. F. Steele, Capt. W. G. Stephenson-Peach, Capt. F. B. Stevens, Sec. Lieut. (A. Capt.) H. N. Stradling, Lieut.-Col. L. H. Strain, D.S.C., Capt. E. S. Sturdee, Lieut. E. A. Sullock, Lieut. F. Susans.

Lieut. A. F. Tabraham, Sec. Lieut. (A. Capt.) R. Tait, Lieut. (A. Capt.) F. G. Taylor, A.F.C., Lieut. A. M. Thomas (Canada); Lieut. (A. Capt.) A. S. Thompson, Maj. (A. Lieut.-Col.) A. A. B. Thompson, M.C.; Lieut. (A. Capt.) W. B. Thomson, Lieut. (A. Capt.) E. Thornton, Sec. Lieut. (A. Lieut.) S. H. Tigg, Lieut. J. F. Titmas, Sec. Lieut. H. Tomlinson, Capt. (A. Maj.) C. G. Tosswill, Lieut. A. C. Townend, A.F.C., Maj. E. G. Toye, Maj. B. Travers, Lieut. (A. Capt.) L. Tunks, Capt. (A. Maj.) E. F. Turner, Lieut. (A. Capt.) F. Tymms, M.C. (Washington).

Capt. G. F. Underwood, Maj. (A. Lieut.-Col.) F. H. Unwin.

Lieut. (A. Capt.) L. M. van Eyssen, Capt. (A. Maj.) J. H. Vickers, Lieut. (A. Capt.) S. J. Vine, Capt. C. Visger, Sec. Lieut. C. Volk.

Capt. H. C. Waghorn, Lieut. (A. Capt.) H. F. Walker, Capt. (A. Maj.) A. G. Waller, M.C.; Lieut. (A. Capt.) J. A. D. Wallis, Lieut. G. P. Walsh, Lieut.-Col. F. A. Wanklyn, M.C. (Canada); Lieut. (A. Maj.) R. W. Ward, Maj. (A. Lieut.-Col.) R. D. Waterhouse, Lieut.-Col. A. T. Watson, Sec. Lieut. J. Y. Watson, Lieut. (A. Maj.) J. B. F. Watson, Capt. F. J. Watts, Capt. D. C. Waylen, Capt. T. Wells, M.C., Lieut. L. W. Wheelock (U.S.A. Air Service in England), Capt. (A. Maj.) R. Whiddington, Sec. Lieut. F. H. Whitmore, D.S.C., Capt. H. E. Whittingham, M.D., Lieut. (A. Capt.) C. A. B. B. Wilcock, Capt. F. Wilkinson, Maj. (A. Lieut.-Col.) R. F. Williams, O.B.E.; Sec. Lieut. (A. Lieut.) F. P. Williams, Capt. F. T. Williams, Lieut. J. G. C. Williams, Capt. O. Williams, Lieut. (Hon. Capt.) H. A. Wilsdon (Washington); Lieut. (A. Capt.) J. Wingate, Lieut.-Col. A. C. Winter, O.B.E., Lieut.-Col. (Hon. Col.) T. B. Wood, C.M.G., Maj. R. H. Woods, M.C., Sec. Lieut. F. A. Worlidge, Capt. E. H. Wray, Lieut. (A. Capt.) H. H. Wrong (Canada); Capt. (A. Maj.) H. E. F. Wyncoll, M.C.

Capt. J. Yates.

Warrant Officers, Non-commissioned Officers and men (including personnel, Women's Royal Air Force) :—

44290 Cpl. E. A. O. Abbott, 77659 Air-Mech.1 (A. Cpl.) F. W. Adcock, 213047 Sgt. Mech. D. A. Alderton, D.S.M., 42721 Ch. Mech. J. Allan, 16760 Ch. Mech. J. A. Allan, 61338 F. Clk. F. J. Alps, 9959 Member Miss D. M. Altham, 403848 Mas. Clk. A. E. Amos, 19504 Member Miss K. Andrews, 59452 A. Sgt. F. S. Anstey, 42817 Sgt. Clk. W. J. Aspinall, 214717 Ch. Mech. E. F. Astie, 2545 Ch. Mec. A. Avery, 56788 Sgt. Mec. B. R. Aylward, 209322 Ch. Mec. A. W. Ayres.

216513 Ch. Mec. W. J. Bagshaw, 11417 Ch. Mec. A. A. Bailey, 33977 Sgt. Mec. J. Bailey, M3647 Ch. Mec. J. E. Bailey, 185032 W.O.2 N. Bailey, 26249 A. Sgt.-Maj. A. E. Baker, 54188 F. Clk. A. W. Baker, 187383 Sgt. Clk. W. H. Ballard (late Lond. Scots); 406405 Cpl. Mec. C. Barr, 12349 Ch. Mec. G. Barrett, 218399 Cpl. Mec. C. Barritt, 27833 A.M.1 (A. Cpl.) A. G. Bassett, 2068 F. Clk. S. C. Bateman, 75270 Cpl. Clk. R. W. G. Bayliss, 4260 Ch. Mas. Mec. C. E. Bean, 50453 F. Clk. S. R. Beck, 202587 Ch. Mec. W. W. J. Reedle, 213438 Cpl. H. G. Beer, 16825 Cpl. Clk. E. R. Belcher, 65857 A. W.O.2 R. Bell, B/14887 F. Sgt. W. G. Bennett, 217984 F. Sgt. F. B. Bennett, 408641 Sgt. Clk. A. J. Berry, 5105 A. Sect. Ldr. Miss M. C. Beyts, 203881 Ch. Mec. T. J. Billingham, 18419 F. Clk. W. Black, 218930 A.M.1 (A. Cpl.) M. B. Blackadder, 21959 Cpl. Clk. T. Bolton, 897 A. Ch. Mas. Mec. W. G. Borrett, M.M., 19757 Cpl. Clk. (A. Sgt. Clk.) A. C. Bowtell, 34089 Cpl. Mec. A. Boyd, 215172 Ch. Mec. C. G. Brackley, 27388 Sgt. (A. Ch. Mas. Mec.) A. Bradfield, 218403 Flt. Sgt. P. J. Brazier, 15997 Cpl. Mec. (A. Sgt. Mec.) H. Briggs, 36208 Sgt. Mec. S. Broad, 56992 Sgt. A. G. Bromige, 6557 Ch. Mas. Mec. E. Brown, 32957 F. Clk. F. L. Brown, 213048 Mas. Mec. R. Brown, 43299 Sgt. Mec. F. C. Browton, 23008 Sgt. Clk. C. H. Buckle, 401647 Flt. Sgt. C. W. M. Bufton, 4419 Ch. Mas. Mec. H. Bull, 950 Ch. Mas. Mec. C. F. Bunting, 217837 Mec. W. Burt, 220237 Ch. Mec. W. G. H. Butcher, 4933 Ch. Mec. S. Byron.

24465 Sgt. Mec. F. A. Cahill, 8397 Sgt. Maj. P. M. Calder, 7183 Mas. Clk. (A. Sgt.-Maj.) G. E. Camp, 12437 Cpl. Mec. W. J. Campion, 43386 F. Clerk H. Carter, 1337 Ch. Sect. Ldr. Miss A. J. Cartwright, 4741 F. Clk. F. C. Catchpole, 87478 Sgt.-Maj. E. Chalk, 231977 Cpl. W. Chalmers, 24266 Ch. Mec. E. E. Childs, 148453 F. Sgt. A. H. Chinnery, 56987 F. Clk. F. C. Clarke, 219998 Sgt. Clk. H. Clark, 217127 Cpl. Mec. A. B. Clarke, J/35985 A. Cpl. W. H. Clarke, 5832 Ch. Mas. Mec. C. H. Clarkson, 15356 W. O. 1 R. Clayton, 215948 Sgt. Mec. B. A. Clinging, 29178 F. Clk. H. D. Close, 10982 Ch. Mec. W. D. Coleman, 206693 Ch. Mec. G. B. Collingwood, 26169 Ch. Mec. H. W. T. Collins, 217356 Cpl. Mec. H. S. Collins, 211246 Sgt. Clk. A. F. Colyer, 1057 Ch. Mec. G. E. Cook, 3350 Ch. Mec. T. Cooke, 3213 F. Sgt. C. W. Corner, 12441 Ch. Mec. W. T. Coveney, 2319 Ch. Mec. A. E. Cowdery, 24066 Sgt. Mec. P. W. Cowell, 130426 Clk. 3 W. Cowie, 210452 Sgt. Mec. H. Cox, 35747 F. Clk. G. Craig, 209076 Ch. Mec. W. C. Cranfield, 62384 Cpl. Clk. C. Creswell, 11825 Sgt.-Maj. A. L. Crewe, 204005 Ch. Mec. A. J. Crook, 9301 F. Clk. H. J. Cross, 23032 Ch. Mec. G. V. Crosthwaite.

13700 A. Sgt. J. T. Davies, 79449 Cpl. Clk. C. P. Davis, 204187 Sgt. Mec. T. Davis, 56555 F. Clk. F. A. Dawson, 405859 A.M. 2 J. Dent, 82913 Sec. Air-Mech. H. U. Diplock, 208279 Ch. Mec. F. W. Dixon, 22066 Ch. Mec. J. Dodd, 24638 Ch. Mec. C. P. Donoghue, 106858 Ch. Mec. R. J. Dowling, 45142 Sgt. (A. Flt. Sgt.) E. Drescher, 77258 Air-Mech. H. P. Drummond, 407846 F. Sgt. F. G. Dudley, 19112 Sgt. M. E. Dudley (11th Sqdn., U.S.A. Air Service), 204972 Cpl. Mec. E. J. Dunber, 24156 F. Clk. R. E. Dunn, 9904 Cpl. J. G. Dunsday (A.P.C., attd. R.A.F.), 8948 Mas. Clk. A. S. Dye, 2430 Member Miss A. Dyer.

220795 Clk. 1 A. Earle, 17046 Sgt. Clk. F. C. Ebben, 216258 Pte. 1 W. E. Edwards, R.N.11616 Ch. Mec. J. Edmunds, 22032 Sgt. Mec. A. Ellams, 402238 Sgt. Mec. H. C. Elliott, 131951 Clk. 1 W. J. Elliott, 217311 Cpl. Mec. A. J. Ellis, 214568 Sgt. Mec. J. C. Emeny, 32594 Cpl. Mec. C. Evans, 20742 Sgt. Mec. J. C. Evans, 108315 Clk. 1 I. M. Evans.

43414 Cpl. (A. Sgt.) S. Fidoe, 2184 Mas. Clk. S. H. Figg, 21054 Sgt. Clk. T. F. Flynn, 65854 W. O. 1 L. J. Fox, 2313 A. Ch. Mas. Mec. F. W. Francis, 1112 Ch. Mas. Mec. J. Fulton, M.S.M., 186744 Mas. Clk. W. Furnace.

203731 Ch. Mec. R. P. Gardner, 201856 Mas. Mec. E. J. Garstin, 45252 Pte. 1 P. Garnett, 401452 Sgt. Clk. A. Gibbons, 210607 Ch. Mec. D. H. J. Gibson, 10901 Ch. Mec. G. Gill, 48973 Cpl. (A. Sgt.) R. E. Godfrey, 12340 Cpl. Mec. (A. Sgt. Mec.) C. J. Goodchild, 212237 A.M. 1 A. W. Goody, D.S.M., 16593 A. Ch. Mec. A. E. Gordon, 210487 Ch. Mec. G. F. Gordon, 5886 Ch. Mec. F. Gould, 23013 F. Clk. G. A. Gough, 33305 Sgt. Mec. J. H. Gough, 11281 Ch. Sect. Ldr. Miss Annie Louise Gravestock, 19250 C. Flk. C. Green, 90012 A. Cpl. C. Green, 57441 F. Clk. C. J. Green, 27996 F. Sgt. H. Green, 203144 Sgt. Mec. W. Green, 216716 Sgt. Clk. F. Greenall, 2087 Ch. Mec. F. Greenhalgh, J/25677 Sgt. Mec. T. E. Greenstreet, 51076 Sgt. Clk. F. D. Greet, 3589 S.M. 1 B. Grey.

28805 Sgt. Mec. R. Hall, 12611 Cpl. J. B. Hancox, 209587 Cpl. Mec. A. H. J. Handley, 200424 Ch. Mec. W. G. Hardy, 64714 Sgt. Clk. C. T. Harper, 1544 Ch. Mec. E. Harris, 50058 Mas. Clk. H. G. Harris, 2287 Sgt.-Maj. C. O. Haslett, 3797 Ch. Sect. Ldr. Miss M. E. Hassett, 1400 W.O. 1 F. R. Haynes, 75628 Cpl. Clk. A. Haythornthwaite, 7591 Ch. Mec. C. E. Hayward, 17737 A./F. Clk. W. E. Head, 209749 Sgt. Mec. A. Healey, 210559 Sgt. Mec. A. W. Hedges, 202497 Sgt. R. Henderscn, 47901 Sgt. Clk. F. Henthorn, 186751 Mas. Clk. A. Hepburn, 6497 Ch. Sect. Ldr. Miss E. E. Hewlett, 76836 Clk. 1 H. Le P. Higgins, 204527 Ch. Mec. W. M. Higgott, 5100 Mas. Clk. (now Sec. Lieut.) T. A. Higgs, 885 Ch. Mas. Mec. E. N. Hill, 6962 Ch. Sect. Ldr. Miss F. N. Hill, 186074 W.O. 2 J. Hill, D.C.M., 5150 Mas Mec. S. Hilliard, 141721 Clk. 2 M. H. Hoad, 203561 A.M. 1 T. Hobbs, 48434 F. Clk. A. E. Hodge, 1414 A. Sgt. J. Hogg, 7317 Ch. Sect. Ldr. Miss M. Holland, 76232 Sgt. Clk. A. E. Hooker, 3946 F. Sgt. M. W. Hope, 4617 Ch. Sect. Ldr. Miss M. A. Houghton, 206097 Ch. Mas. Mec. G. Huckle, 4098 Ch. Mas. Mec. G. A. Hummerstone, 2564 Ch. Mec. J. W. Humphrey, 205484 Ch. Mec. F. H. Humphreys, 1763 Ch. Mec. F. Hutch.

200474 Ch. Mec. A. T. Ibbott, 238474 Cpl. (A. Sgt.) J. Inglis, 24850 Ch. Mec. E. H. Isherwood.

16367 Sec. Ldr. Miss I. Jack, 32096 Cpl. Clk. P. F. James, 7515 F. Sgt. H. Jarvis, 2434 Member Miss I. Jeeves, 203870 Ch. Mech. S. L. Jeffries, 31008 Ch. Mec. C. E. Jenks, 2528 Member Miss K. H. H. Jessopp, 2592 A. Ch. Mas. Mec. H. N. Johnson, 6898 Sgt.-Maj. T. G. Jones, 4465 F. Clk. J. J. A. Justice.

30533 Ch. Mas. Mec. W. Kay, 88243 Sgt.-Maj. J. Kearnes, 200718 Ch. Mec. G. Keevil, 202847 Sgt. T. Keiller, 1848 Sgt. Mec. T. Kenyon, 200700 Ch. Mec. F. Kerchey, 1717 Sgt.-Maj. C. H. Kernot, M.C., M.M., 36313 Mas. Clk. A. M. Kettle, 15096 Ch. Mec. J. Kimberley, 6230 F. Clk. C. H. King, 5847 Ch. Mec. H. Kinge, 275 F. Mas. Mec. R. Kirk, 201678 Sgt. Mec. P. R. Kirton, 48742 Cpl. S. W. Kitchen, 57488 Sgt. Clk. (A. F. Clk.) C. E. W. Knight, 6208 Mas. Clk. F. Knight.

2343 Ch. Sect. Ldr. Miss F. E. Ladds, K. 12282 Sgt. Mec. G. H. Lade, 42885 Sgt. H. J. Ladkin, 11283 Sgt. Clk. C. C. La Haye, 69596 Clk. 1 F. G. Langabeer, 49828 Sgt. Clk. R. O. Langley, 213975 Sgt. Mec. R. Leason, 210692 Ch. Mec. A. D. Le Croisette, 3392 Ch. Sect. Ldr. Miss E. Lee, R. N. 233806 Sgt. Mec. F. Leech, 122099 F. Clk. P. L. Leopold, M/12955 Mas. Clk. W. Leverson, 47604 F. Clk. R. T. Lever, 212212 Ch. Mec. W. E. O. Lewington, 19114 Sgt. H. E. Lewis (11th Sqdn., U.S.A. Air Service), 209337 Sgt. Mec. J. Lewis, 205450 Sgt. Mec. R. C. Lilley, 247134 Clk. 3 C. Liney, 2880 Sgt. Mec. R. Little, 57505 Sgt. Clk. T. B. Lockwood, 204255 Sgt. Mec. T. C. London, 69123 Cpl. R. S. Lowe, 10872 Mas. Mec. W. J. Luke.

210584 Ch. Mech. E. H. McCarthy, 88025 Sgt.-Maj. G. A. McDonald, D.C.M., 299 C.P.O. H. McGuffie, 212534 Sgt. Mech. W. H. McKaig, 10875 F. Clk. A. W. Maber, 166340 Sgt. (A. W.O.) G. A. Maddams, 13747 Cpl. Mec. A. A. Madgwick, 204718 Ch. Mec. G. F. R. Marden, D.S.M., 10002 Sgt. Mec. J. T. Marks, 3685 Sgt.-Maj. G. Marriner, 1382 Sgt.-Maj. G. G. N. Marshall, R.N. 12060 Sgt. G. Martin, 402479 A. Ch. Mec. H. S. Martin, 1473 Ch. Mec. J. W. Martin, 56954 F. Clk. V. Martin, 3940 Ch Mas. Mec. J. Matthew, 18871 Sgt. Mec. R. W. Mayo, — Actg. Cpl. L. E. Meckel (163rd American Aero Sqdn.), 115589 Cpl. E. H. Mee, 21411 1st Air-Mech (A. Cpl.) G. V. Mew, 103244 Ch. Mec. W. H. Millener, 207450 Sgt. Mec. R. G. Miles, 214838 Ch. Mec. D. Moore, 1395 Ch. Mec. E. E. Moore, 67894 Mas. Clk. C. H. Morgan, 204681 A. Mas. Mec. H. Morris, 4034 Sgt. Mec. S. R. Morrison, 205548 Ch. Mec. A. M. Mummery, 210615 Ch. Mec. J. McC. Mundell, 4793 Sgt. Mec. J. H. Murphy.

202272 Ch. Mec. H. W. Newill, 1321 A. W.O. R. Nicholls, R.N.134725 Ch. Arm. W. Ninnis, 15469 Ch. Sect. Ldr. Miss E. Noble, 23233 Sgt. Clk. W. F. Norman.

114087 A.M. 2 B. S. Oliver, 57912 Sgt.-Maj. P. C. O'Neil, 218444 Ch. Mec. J. McC. Orr, Sig. R.N.V.R. LZ1159 A. R. Osborne, 200791 Ch. Mec. L. C. Ottley.

243789 Pte. 2 C. H. Pannell, 186411 F. Clk. E. Parker, 1284 W.O. 1 F. T. Parker, 5134 Q.M.S. H. C. Parker (R.E.), 401860 Ch. Mech. R. Parker, 9010 Ch. Mech. F. G. Parry, 144083 Clk. 2 F. C. Patterson (late Rif. Bde.), 79172 Cpl. E. H. Payne, 222207 1st Clk. G. F. Pearce, 16601 Sgt. J. E. Pearsall, 50557 F. Clk. E. L. Peck, 9960 Ch. Sect. Ldr. Mrs. N. P. Peckover, 209254 F. Clk. M. F. Penney, 231179 Cpl. A. Peters, 28212 Cpl. (A. Sgt.) W. H. Petrie, 61650 Ch. Mec. F. W. Pettitt, 20993 Ch. Mec. P. Pickering, 44367 F. Clk. H. V. Pinks, F4491 Ch. Mec. A. Pitt, 12518 Member Miss M. D. Pope, 210222 Ch. Mec. H. Postill, J30535 Cpl. Mec. W. A. Potter, 205035 Ch. Mec. T. R. Powell, 206103 Cpl. B. E. Pretty, 214629 A.M. 1 C. Prevett. R.N. 222569 Ch. Mec. G. Prickett, 187426 Sgt. B. Probeart, 76989 A. Cpl. A. W. Prutton, 148611 Sgt.-Maj. H. Pryde, 43817 W.O. 1 G. J. Pullen, — Member Miss J. Pusey (Steventon, Berks); 216888 Sgt. Mec. W. S. Pyle.

1095 Ch. Mas. Mec. F. H. Ramsay-Williams, 6250 Cpl. Mec. S. Ranby, 166039 W.O.2 L. A. Rancom, 228500 A. F. Clk. R. W. Rea, 50474 F. Sgt. R. Regan, 34351 Ch. Mec. J. Reid, 29604 Sgt. D. J. Richards, 206454 Ch. Mec. R. W. Ritchie, 211697 Sgt. O. F. Roberts, JH4217 Ch. Mec. W. J. Robinson, 80244 Sgt. Clk. G. H. Rogers, 16075 Ch. Mec. H. K. Rolfe, 1878 Ch. Mec. A. J. Rule, 39147 Ch. Mec. A. Rushworth, 214777 Cpl. Mec. A. S. Ryall.

7660 Ch. Mec. C. Sadler, 401295 Ch. Mec. T. Satchell, 114496 A.M. 2 C. Sanders, 513 Ch. Mas. Mec. E. W. C. Saunders, 6743 F. Clk. R. Schofield, 212599 Ch. Mec. T. W. Scott, 48563 Cpl. Mec. A. A. Scrase, 9590 Ch. Sect. Ldr. Miss S. I. M. Seale, 26165 A. Sgt.-Maj. C. Self, 7772 F. Clk. J. L. Semper, 211460 Sgt.-Maj. E. W. Sensecall, 36089 F. Clk. W. C. Shelton, 31183 F. Clk. W. M. Shepherd, 116 F. Clk. B. A. Sheppard, 26345 F. Clk. S. Shipman, 185776 F. Sgt. W. E. Short, 30449 Cpl. Mec. (A. Sgt.), F. C. H. Simmonds, 201551 Sgt.-Maj. F. W. Sims, 233383 Clk. 2 R. F. Skinner, 125801 A. Cpl. A. Smith, 200471 Sgt. Mec. A. N. Smith, 231684 A.N. 1 B. Smith, R.N.239557, Ch. Mec. C. W. Smith, N.236653 Sgt. Mec. G. Smith; 228040 Sgt. Mec. G. W. Smith, 25775 Ch. Mec. H. W. Smith, 5435 Ch. Mas. Mec. S. J. Smith, 6915 Sgt.-Maj. T. Smith, 144 Ch. Mas. Mec. W. Smith, 46402 Sgt. Mec. W. Smith, 6167 Ch. Mec. A. G. Sorfleet, 75540 Clk. 1 H. Spears, 47759 F. Clk. H. S. Speed, 409050 Sgt. Clk. C. Spencer (late Berks Yeo.), 203137 Sgt. Mec. G. Spragg, 409306 F. Clk. W. N. Stanley, 209756 Sgt. Mec. P. L. Stephen, 9994 Sgt.-Maj. P. S. Stewart, 18551 A. Ch. Mec. W. M. R. Stewart, 22688 F. Clk. A. J. L. Stichbury, 26871 A. Cpl. W. Still, 409448 Cpl. A. Stimson, 48408 A.M.1 W. Sturge, 8435 F. Sgt. G. Sturman, 199654 2nd Clk. E. Sudgen, 208242 Ch. Mec. G. F. Swallow, 19068 Sgt. W. G. Swatton.

216648 Sgt. Mec. A. W. Taylor, 186179 Sgt. Clk. C. W. Taylor, 5255 Sgt. Mec. H. J. M. Taylor, 7188 Ch. Mas. Mec. T. E. Terry, 200141 Mas. Mec. F. S. Thatcher, D.S.M., 14132 Ch. Mec. T. W. Thompson, 225719 Cpl. A. J. Tibbett, 1986 Ch. Mas. Mec. H. N. Tomblin, 251603 2nd Clk. A. F. Tomkins, 34428 F. Clk. G. W. Tovey, 204593 Ch. Mec. W. A. E. Tredwell, 211809 A.M. 2 J. W. Trevelyan, 1062 Ch. Mec. C. L. Trevithick, 238911 A.M. 2 G. H. Tucker, 203513 Sgt. Mec. J. Turley, 2070 Sgt. G. E. Turner.

250146 Cpl. G. D. Umpleby, 18349 F. Clk. F. C. Utting.

76841 Sgt. Clk. H. Veness, 187225 Clk. 1 W. D. Venning, 5969 Sgt. Clk. F. Vickers.

405797 Clk. 2 T. E. Wade, 201767 Ch. Mec. G. T. Wait, 9225 Member Miss M. A. Walker, 218473 Sgt. Mec. T. Wallace, 11130 Member Miss D. M. Wallis, 569 A. Ch. Mas. Mec. J. Walls, 234917 Ch. Mec. R. T. Ward, 1068169 Pte. W. L. Ward (219th Sqdn., U.S.A. Air Service); 40441 Ch. Mec. A. G. Warwick, 216650 Sgt. Mec. W. Wates, 238959 Cpl. Clk. A. H. Watkins, 218299

FLIGHT & AIRCRAFT ENGINEER

F. Clk. W. A. Watson, 89034 F. Sgt. F. W. Watt, 4848 Member Miss E. W. Watts, 187484 F. Clk. V. B. Watts, M.M., 205003 Sgt. Mec. H. Wearne, 39869 Cpl. Mec. J. I. Webster, 409109 F. Clk. D. C. G. Webster, 11624 Ch. Mec. A. Welfare, 4841 Ch. Sect. Ldr. Miss A. Were, 8104 Ch. Mas. Mech. H. W. Westbrook, 214703 Sgt. H. N. D. Whall, 5779 Ch. Mec. F. White, 18715 F. Sgt. F. E. White, 214784 F. Clk. W. C. White, 1644 Ch. Mas. Mec. H. G. Whyte, 21963 F. Clk. H. Wilkinson, 47723 A.M. 1 J. Wilkinson, 204581 Cpl. Mec. F. A. Williams, 203155 Sgt. Mec. W. H. Williamson, 207691 Sgt. Mec. A. G. Willis, 14106 Ch. Mec. A. P. Wilson, 211134 Sgt. Mec. S. Wise, 1135 Ch. Sect. Ldr. Miss A. Witham, 223485 Sgt. Clk. A. M. Wood, 200540 Ch. Mec. C. W. Wood, 7296 A. Mas. Clk. H. Wood, 202521 Ch. Mas. Mec. J. W. Wood, 10342 Mas. Mec. C. J. Woodcock, 12532 F. Clk. E. L. Woodward, 98812 Sgt.-Maj. J. Wortley, M.M., 2425 Member Miss J. E. Wyatt.

84505 Cpl. E. Young, 5793 Ch. Mec. F. B. Young, 461 Ch. Mec. J. Young, 203697 Cpl. Mec. W. V. Young.

The following members of the Civilian Staff employed by or serving in connection with the Air Ministry have been brought to the notice of the Secretary of State in respect of valuable services rendered in connection with the war :—

A. Allen, E. S. Andrews, E. Backhouse, H. B. C. Baldwin, C. J. V. Bland, J. C. Boyle, G. Brewer, F.A.S., W. A. R. Channer, G. B. Cockburn, O.B.E., H. D. Courtenay, J. Cruickshank, H. J. Culpin, C. Deane, R. D. Dow, G. W. Dyke, W. S. Field (Hon. Sec., R.A.F. Hospitals) ; W. F. Glass, E. A. Griffiths, A. Hooper, M.D., H. Hughes (Chief Surveyor, Works and Buildings) ; M. H. Jackson, C. Marsh, V. J. Mitchell, A. R. Moss, F. W. Phillips, G. A. Pitt, W. J. Pryce, G. Reeves, P. Salmon, H. E. Shrimpton, H. L. Stevens, P. H. Taylor, C. W. C. Venus, T. H. Walsh, W. R. Watson, R. P. Wilson.

Ladies

Mrs. L. Allen, Mrs. G. E. Bailey, Mrs. H. Bayliss, Miss E. Berry, Miss E. M. Bowrey, Mrs. E. Brierley, Miss D. E. Bursell, Mrs. M. Carnley, Deputy Principal, W.R.N.S. (attd. R.A.F.), Miss B. M. Cave-Brown-Cave, Miss E. M. A. B. Clapp, Miss M. Clements, Mrs. E. E. Collins, Mrs. M. Cooke, Mrs. F. Cory-Wright, Miss M. G. Clutterbuck, B.A., M.B.E., Miss M. Davies, the Hon. Mrs. D. Dawnay (Comdt., Hollington Hall Convt. Home), Miss E. Day, Miss C. Dibdin, Miss A. G. Dixon, Miss D. E. Dunn, Mrs. E. Edgar (Comdt., Chalfont Park, Convt. Home), Miss K. F. Edgar, Miss G. Edwards, Miss L. Excell, Miss B. M. Fellowes, Miss M. G. Fort, Miss M. A. Fryer, Miss M. C. Gordon, Miss E. L. Gibbons, Miss A. M. Gray, Mrs. L. Hawksworth, Mrs. E. Howell, Miss I. Haynes, Mrs. W. G. Isom, Mrs. L. Jennings, Miss W. Le Warne, Miss E. J. Littlejohn, Miss A. W. Lyon, Miss H. McDiarmid, Miss D. Macgregor, Mrs. E. M. Mallet, Mrs. A. Marinden, Miss N. G. Mayor, Mrs. A. Mullinan (Comdt., Clifton Court Convt. Home, Rugby), Mrs. F. L. Ord, Miss H. R. H. Powell, Miss C. Reynolds, Miss M. G. M. Ryder, Miss J. G. Sandwith, Miss A. L. Sharp, Mrs. A. L. Shutt, Miss M. E. Sincock, Mrs. M. N. Smith, Miss M. South, Miss B. M. Stinton, Miss W. A. Tayler, Miss M. Thomas, Miss W. G. Trew, Miss M. J. Valentine, Miss L. A. F. Vaucour, the Hon. Mrs. D. Vickers, Miss A. J. Vine, Miss B. Wakefield, Miss A. L. West, Miss D. W. Westoll, Mrs. E. Wetherstone, Miss N. G. Wilson, Miss M. Yorke.

THE ROYAL AERO CLUB OF THE U.K.

OFFICIAL NOTICES TO MEMBERS.

FLYING SERVICES FUND COMMITTEE.

A MEETING of the Flying Services Fund Committee was held on Thursday last, the 23rd inst., when there were present : Lieut.-Col. T. O'B. Hubbard, R.A.F. (in the Chair), Mr. Chester Fox and Lieut.-Com. H. E. Perrin, R.N.V.R. (Secretary).

Grants and Allowances.—The following Grants and Allowances were made :—

134. An allowance of £2 a month for six months to the widow of a Sergeant in the Royal Flying Corps who had died on active service.

126. An allowance of £2 a month for six months to the widow of a 2nd Class Air-Mechanic in the Royal Flying Corps who had died on active service.

132. An allowance of £1 a month for six months to the mother of a Private in the Royal Naval Air Service who had died on active service.

130. An allowance of £2 a month for six months to the mother of a Private in the Royal Flying Corps who had died on active service.

128. An allowance of £2 a month for six months to the mother of a Sergeant in the Royal Flying Corps who had been killed on active service.

34. An allowance of £3 a month for six months to a 2nd Class Air-Mechanic in the Royal Flying Corps who had been incapacitated on active service.

123. An allowance of £2 a month for six months to the sister of a Private in the Royal Air Force who had died on active service.

131. An allowance of £2 a month for six months to the widow of a Private in the Royal Air Force who had been killed on active service.

112. An allowance of £2 a month for six months to the widow of a 1st Class Air-Mechanic in the Royal Air Force who had been killed on active service.

138. An allowance of £2 a month for six months to the widow of a Private in the Royal Flying Corps who had died on active service.

THE FLYING SERVICES FUND

(Registered under the War Charities Act, 1916)

Administered by the Royal Aero Club

For the benefit of *Officers, Non-Commissioned Officers and Men* of the ROYAL AIR FORCE who are incapacitated on Active Service, and for the Widows and Dependants of those who are killed.

Honorary Treasurer :
The Right Hon. LORD KINNAIRD.

Committee :
Lieut.-Col. T. O'B. HUBBARD, M.C., R.A.F. (*Chairman*).
Mr. CHESTER FOX.
Lieut.-Col. HARCOURT G. GOLD, R.A.F.
Lieut.-Col. C. E. MAUDE, R.A.F.
Brig.-Genl. R. H. MORE, C.M.G., R.A.F.

Secretary :
Lieut.-Com. H. E. PERRIN, R.N.V.R.

Bankers :
Messrs. BARCLAYS BANK, LTD., 4, Pall Mall East, London, S.W. 1.

Subscriptions	£	s.	d.
Total subscriptions received to Jan. 21st, 1919	14,571	3	4
South-Western Recreational Training Association, Headquarters, South-Western Area, Royal Air Force, Salisbury (Eighth donation, making a total of £1,086 3s. 6d.) ..	77	14	1
H.M. Air Station, Newlyn, Cornwall	7	10	0
260 Squadron R.A.F., Westward Ho	29	2	9
R.N. Air Station, Killingholme	116	18	5
Blackburn Aeroplane and Motor Co., Ltd., Leeds (collection in Works)	11	12	0
Total, January 28th, 1919	14,814	0	7

Offices : THE ROYAL AERO CLUB,
3, CLIFFORD STREET, LONDON, W. 1.
H. E. PERRIN, Secretary.

THE ROLL OF HONOUR

Published January 22

Killed

Dallas, Sec. Lieut. W. R. — Poole, Sec. Lieut. R. B.
Milligan, Sec. Lieut. J. — Willis, Sec. Lieut. G. W.
O'Grady, Sec. Lieut. J. H.

Died

Beesley, Sec. Lieut. A. B.

Published January 23

Previously Missing, now reported Killed

Brown, Sec. Lieut. R. S. (Aust. F.C.). — Tonks, Sec. Lieut. H. A. C. (Aust. F.C.).
Davis, Lieut. W. R. B. (Aust. F.C.).

R.A.F. Cadets Killed

Davies, H. J. — McWhinnie, D. — Thompson, C.
Lindsay, R. — Scarratt, J. A.

Published January 25

Killed

Bruce, Lieut. J. A. — Marks, Sec. Lieut. C.

Previously Missing, now reported Killed

Hewson, Sec. Lieut. T. (Aust. F.C.).

Died of Injuries

Hillock, Sec. Lieut. C. A. — Vincent, Lieut. F. C.

Died

Barnato, Capt. J. H. W. — Wakeford, Sec. Lieut. W. S.
Nixon, Lieut. S.

BRITISH AIR POWER

THE following official figures show briefly the great growth of the British air service. In August, 1914, the R.F.C. and the R.N.A.S. between them mustered a total strength of only 285 officers. On November 11 last year the R.A.F. total of officers was 30,000, of whom 10,000 were pilots and 2,000 observers, on the active service list. Other ranks in 1914 numbered 1,853, and in 1918 there were 264,000, of whom 21,000 were flying cadets in training for commissions.

The total of our aeroplanes at the outbreak of war was 166. At the close of hostilities there were 21,000. We possessed 45 seaplanes in 1914, and 1,300 at the finish, while airships grew in numbers from seven to 103 by the end of the war. There were 25,000 aeroplanes and seaplanes on order on November 11, 1918, together with 55,000 engines.

In August, 1914, there were only four squadrons of the R.F.C. in existence, but last November the total was over 300, consisting of about 200 service squadrons, 50 training squadrons, and 60 training depôt stations. The membership of the W.R.A.F., which was non-existent in 1914, stood, at the close of hostilities, at 23,000.

THE WORK OF SECTION T.5, R.A.F.

NOT the least astonishing accomplishment in the building up of the R.A.F. has been the training of an enormous personnel, consisting in 1914 of a mere nucleus of a few hundred men and officers, and which counts many thousands at the present time. In order to accomplish this, special methods of instruction have had to be evolved, as a great percentage of those to be trained were "non-technical" men, in the engineering sense, and the time did not allow of training in the usual way. The magnitude and efficiency of the personnel of the R.A.F. show that this training *has* been accomplished, and that in a highly satisfactory manner, and it is not too much to say that but for the special methods evolved this could not have been done in the time. These methods having proved so successful in times of war, there can be no doubt of their educational value, and bearing in mind that in the future the successful development of commercial aviation will be of vital importance to the British Empire, it would appear that the retention of such departments whose work during the War has been mainly of an educational value follows as a matter of course. We have no information as to what it is intended to do with these departments after the War, but it would not appear improbable that many, or all, of them will be absorbed by other Government departments on the plea that their existence was purely a war measure, and that in the future they will not be required for peace purposes. This may apply to a number of the R.A.F. departments, and justly so, for instance, to those that have been dealing with problems of production, since it cannot be imagined that peace production will be on the same scale as was War production, but in the case of the educational departments it does appear to us that it is of the very greatest importance to retain, and even enlarge these, with a view to assist in educating the coming generation, whose task, and privilege, it will be to develop the commercial aviation of the future. From what we have seen of the training methods evolved during the War, we are convinced that these could easily be modified and greatly extended, so as to be applicable to peace conditions.

Among the departments whose work has been of an educational nature is Section T.5 at South Kensington, and a few remarks concerning the work and organisation of this department may be of interest.

The existing Section T.5, is a development of the R.F.C. Data and Drawing Office, which was established in August, 1916, at No. 1 School of Military Aeronautics, Reading. At that time very little technical information was available in a form suitable for the requirements of the Service, and the object of the office at Reading was to collect technical information and translate it into such a form as to render it capable of being easily understood by the average officer, N.C.O., and man in the R.F.C. Such information was issued in the following forms :—

1. Technical notes, written in a simple manner.
2. Coloured diagrams of aero engines, aero instruments, armament, mechanical transport, etc.
3. Rigging diagrams.
4. Lantern slides.
5. Models.

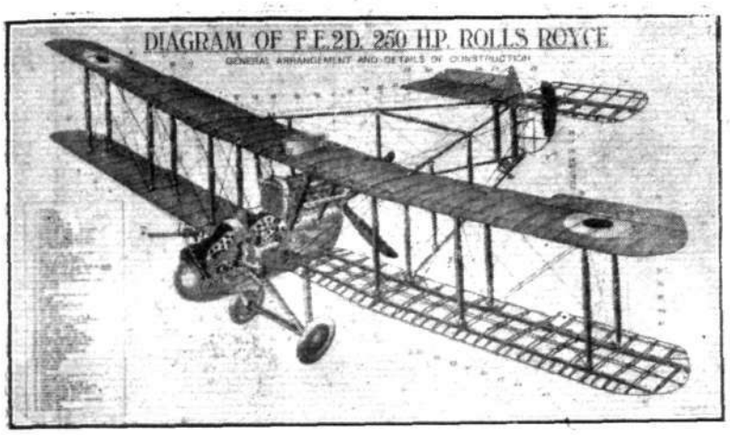
Major MacCallum and some members of his staff in the office of the O.C., Section T.5.

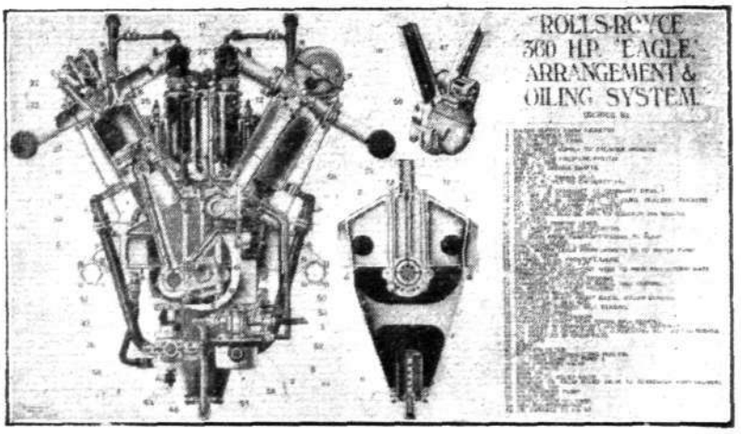
By this means an attempt was made to bridge the gap between the trained and the untrained mind.

At the end of March, 1917, the data and drawing office became a section of the then newly-formed Air Board Technical Department, and the whole staff and plant was transferred from Reading to the Royal College of Science, South Kensington. Under these new conditions it was designated "Section T.5," becoming at the same time the central agency for the distribution of all technical information circulated by the Air Board Technical Department.

Since the removal to South Kensington considerable expansion has taken place, and the Section T.5 has been equipped with the necessary machinery and accessories, and organised as a centre for the prompt supply of technical information to the R.A.F., Government Aeronautical Contractors, and the Allies.

It is a matter of some satisfaction that the issues to the Allies have resulted in the institution in Allied countries of





A reproduction of two of the " Normal " type of coloured diagrams produced by Section T.5. On the right a transverse section of a Rolls-Royce aero engine, and on the left a diagram of the F.E. 2D.

similar centres modelled upon the R.A.F. centre at South Kensington.

Organisation

As constituted at present, Section T.5 has a total staff of approximately 400, of which about 50 per cent. are women. The whole organisation is in charge of Major A. H. S. MacCallum, R.A.F. It is divided into six sub-sections, each of which have defined duties, and are designated as follows :—

Designation.	Duty.
T.5 (A)	Administrative and Disciplinary.
T.5 (D)	Preparation of Diagrams illustrating technical subjects.
T.5 (N)	Preparation of Technical Notes.
T.5 (I)	Preparation of Illustrations as required by T.5. (N).
T.5. (P)	Printing of technical letterpress, line and half-tone illustrations and litho work.
T.5. (R)	Handling of correspondence and the distribution of publications.

As for the duties of the various Sections, those of T.5 (A) are administrative and disciplinary. The R.A.F. personnel is borne on the strength of the Technical Printing Section, while the civilian staff is employed by the M.O.M.

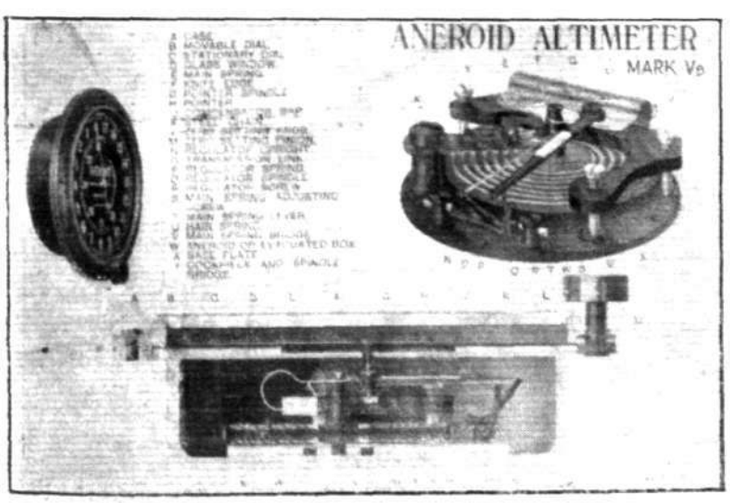
T.5 (D).—The Diagrams Section, is responsible for the production of three different types of diagrams. " Normal " and Schematic diagrams, Rigging diagrams, and " Pictorial " diagrams. The " Normal " type of diagram is a coloured drawing, representing accurately the details of the article depicted. For example, suppose an aero engine is to be illustrated. From the blue prints of a sectional view of the engine a black-line drawing is made by the " true-to-scale " method. This is then coloured in the manner required by the use of the " Aerograph." Later on a set of these coloured drawings are passed on to the lithographic department, where they are printed in larger quantities for distribution generally. These " Normal " diagrams are true in every respect, and are intended for the use of those not readily able to " read " an ordinary blueprint or engineering drawing. That they serve their purpose admirably is beyond doubt, and an enormous amount of good work might be done by the, lavish distribution of these diagrams to all our universities and colleges that run engineering classes. We would even go further than that, and say that diagrams of this type, dealing with all the various subjects connected with the mechanical and aerodynamical side of aviation should be produced in great quantities and distributed to all the schools in the country, care being taken to commence the issue with fairly simple subjects and gradually working towards the more complicated ones. We venture to say that in this way the interest of the younger generation—which will have to make aerial locomotion particularly its own—would be aroused, and once that is accomplished the teaching follows naturally, and the knowledge is imparted with a minimum of trouble. We would suggest that this subject be taken up by the Board of Education.

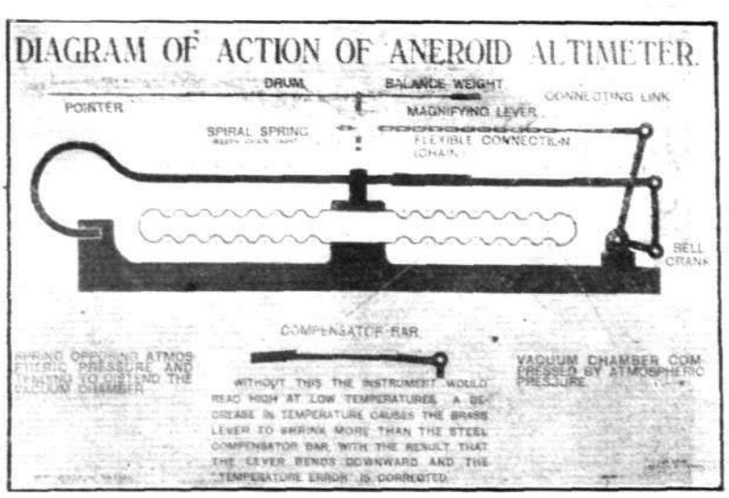
In addition to the coloured diagrams, schematic diagrams are issued. These are intended to show the action and principle of a certain mechanism rather than being a true representation of the mechanism itself.

The *rigging diagrams* are re-produced in a similar way, by lithography, and are intended to give full instructions for the standard rigging and trueing up of service machines. Reduced and suitably modified copies are included in the corresponding rigging notes.

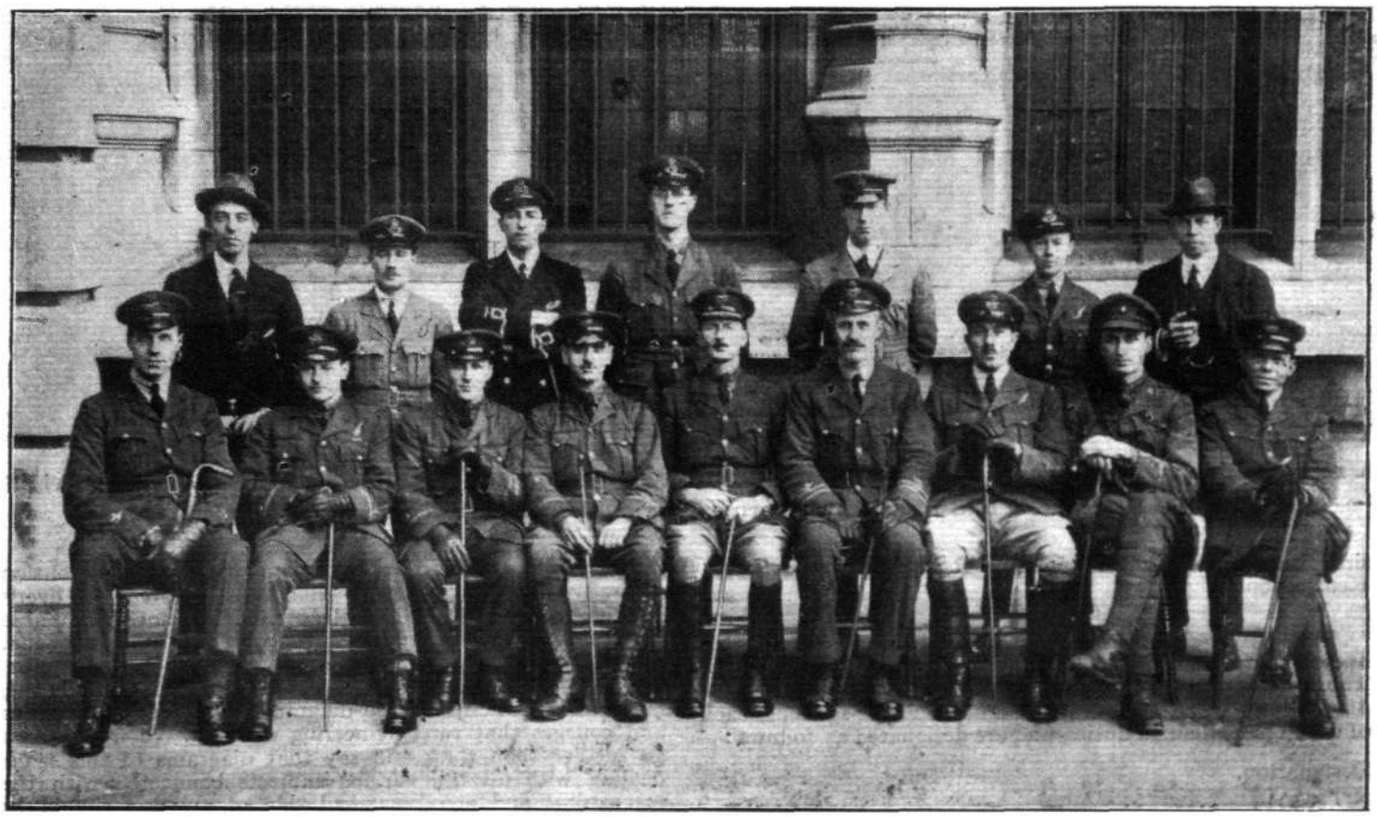
The *" pictorial " diagrams* are the outcome of an experiment made at Reading before the transfer to South Kensington.

It was found that the officers under instruction frequently failed to grasp or to attach sufficient importance to many of the fundamental points that were brought to their notice in the lectures on " Fighting in the Air," " General Flying,"





The " Normal " type of coloured diagram issued by T.5. is a true representation of the object, while the corresponding schematic diagram shows the principle. In the illustration the " Normal " diagram is shown on the left, while the right-hand photograph shows a schematic diagram.



A group of the officers who are responsible for the various departments of Section T.5.

etc. As an example, examination results showed conclusively that, in spite of careful explanation during lectures many candidates failed to appreciate a point of which no illustration could be shown. The first picture appealed so strongly to the officers under instruction that it was decided to develop the idea and to adopt this means of dealing with the difficulty explained above. These diagrams deal with such subjects as the dangers of landing across the wind and flattening out too soon or too late, and all the thousand and one pitfalls that beset the path of a pupil learning to fly. Similar diagrams deal with problems of formation flying, fighting in the air, "stunts," etc.

T.5 (N).—The staff of this section is composed mainly of officers who are responsible for the production of notes on aero-engines and aeroplanes, simply written so as to be easily understood by pilots as well as mechanics.

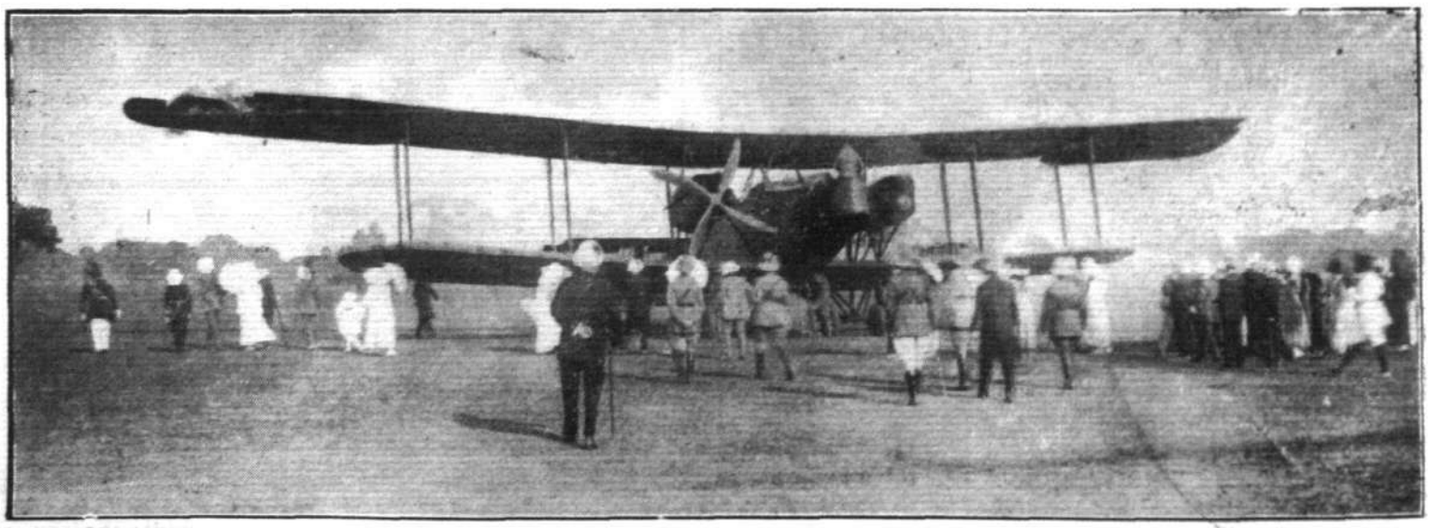
The illustrations for the notes on engines and machines prepared by T.5 (N) are produced by the *Illustrations Section*, T.5 (I) which is staffed by black-and-white artists and aerograph operators under the control of an experienced civilian illustrator.

The Printing Section, T.5 (P) deals with specially confidential work such as the printing of R.A.F. Technical Orders and the Controller's Fortnightly Report. It also prints the notes issued by the other departments, and has its own engraving plant for the making of line blocks and half-tones, illustrating the reports.

T.5 (R).—This section is responsible for the distribution of all the technical literature, diagrams, etc., produced by the other sections, and according to the official list issued at frequent intervals so as to be always up to date, comprises, at the time of issuing the eighth edition of the list, some 3,500 items.

Space does not permit a more detailed reference to the work of T.5, bu. sufficient has, we think, been said to give some indication of the variety and magnitude of the work, and we trust that although T.5 came into existence as a War measure it will be retained in some form or other to continue the good work.

The officers in charge of the various sections are: *Administrative*—Lieut. B. C. Rayner. *Technical Notes*—Mr. P. V. Hoare. *Engine Notes*—Lieut. A. F. Cressall. *Instructional Diagrams*—Lieut. L. G, Sewell. *Illustrations*—Lieut. A. F. Perry. *Pictorial Diagrams*—Mr. G. H. Davies. *Printing*—Lieut. A. L. Thomas.



The England-India Handley-Page's arrival at Calcutta Racecourse, from Allahabad, the last stage of the journey from England. The Viceroy and the Governor of Bengal advancing to receive Generals Salmond and Borton immediately upon the landing of the "H.P."

FLIGHT
AIRCRAFT ENGINEER

AIRISMS FROM THE FOUR WINDS

WHO said : " Do in the Airship Service " ?

\- - -

AND who capriciously and suddenly closed down one and all of the airship stations ?

\- - -

IT'S a poor sort of recommendation for the retention of a Real Brass Hat, for that R.B.H., when it cannot have its own way in the moment, the Shine of the said R.B.H. being thereby dulled somewhat, to lose its temper and do peevish things, when the results may seriously affect National and Imperial interests.

\- - -

WHAT the rest of the B.H.'s think of it.

\- - -

AND how the rank and file regard it.

\- - -

WHAT view Parliament will take of the intriguing at the nation's expense.

\- - -

NOTHING like exact figures to convince. 217,545 was the grand total of visitors to the R.A.F. Exhibition of enemy aircraft at the Agricultural Hall, when it finally closed its doors. The R.A.F. hospitals and Lord Roberts' Memorial Workshops are now, between them, the richer by £10,768, plus £590, derived from the sale of souvenirs of enemy aircraft during the Show, as a result of this Exhibition.

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EVEN this does not finish their career, as those relics which are suitable, before taking a permanent place presently in the National War Museum, will be available in different towns in the Provinces, for the purpose of attracting more gate-money for the benefit of the hospitals or other good institutions.

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AT the Victory matinée on February 2 at the Coliseum, in aid of the Fund for dependents of British Sailor and Soldier journalists, quite a unique lot of War-time relics will be disposed of by auction to swell the Fund. Aviation could hardly be left out of such an opening to do good, and in the list are a notable R.A.F. photograph of a bombed Rhine town and a German aeroplane propeller of the type favoured by Richthofen.

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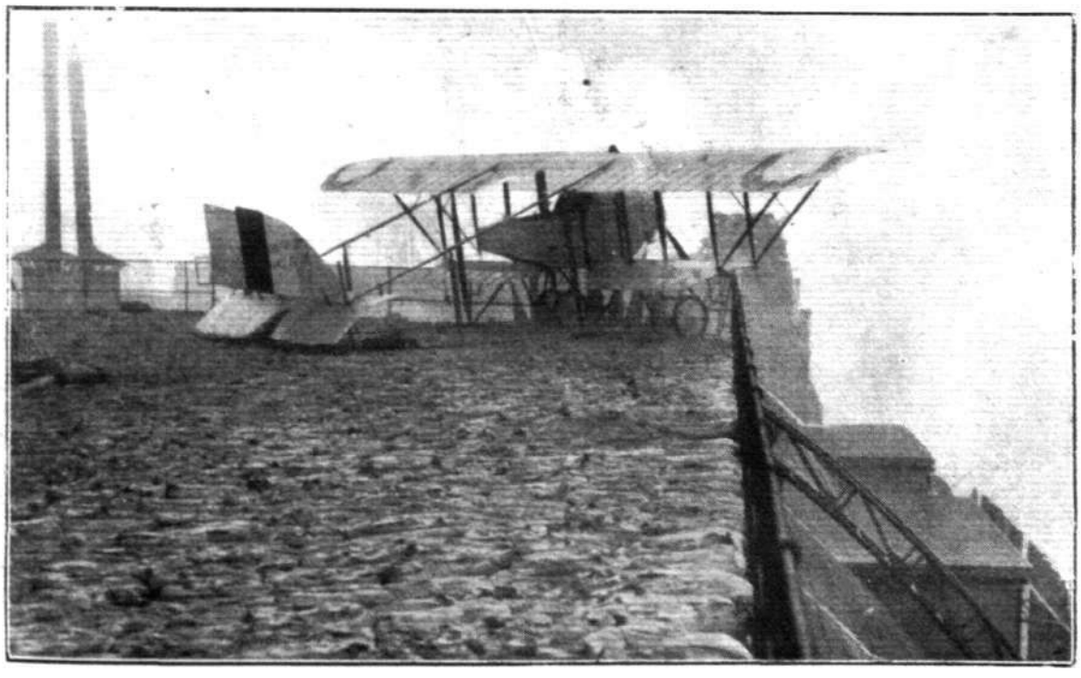
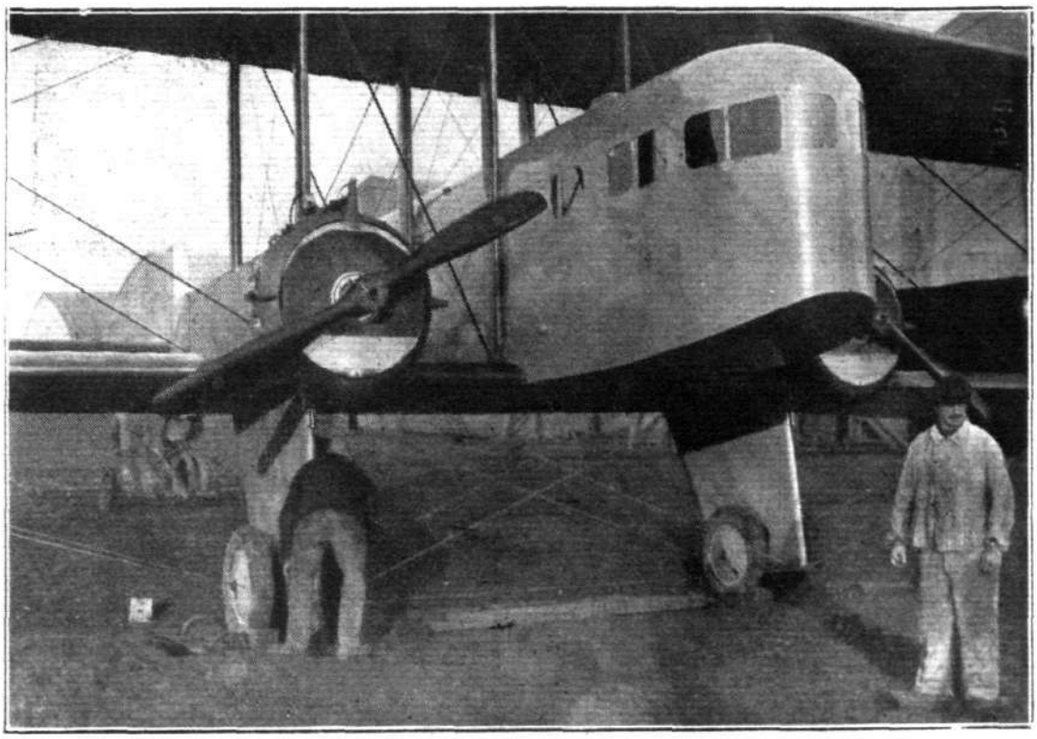
AFTER all, it was the Clerk of the Weather who at the finish stepped in to stop the Paris-England aerobus pioneer journey last Sunday, after the militarising of the Farman machine had got over the difficulty of the position brought about by the British authorities' refusal to allow the trip to be made by a private commercial firm. Although the temporary restrictions in this connection are without doubt very irksome, there is a good deal to be said upon the official

Vedrines' feat of landing on the roof of the Galeries Lafayette in the Boulevard Hausmann, Paris. The 80 h.p. Caudron as seen from the street



Vedrines' 80 h.p. Caudron on the roof of the Galeries Lafayette, after it had been secured at the corner of the roof so as to be visible from the street. Note the sandbag protection against Hun bombers



A view from in front of the centre of the Farman Paris–England Service Aeroplane, showing the engines and passengers' cabin. There are two engines of 250 h.p. each, giving the machine a speed of 110 m.p.h.

side for going a bit slowly. All the same the sooner the details are thrashed out defining the regulations and limits under which flying may be indulged in generally, the better for the solid founding of the commercial aviation industry. It is to be hoped that red tape and the ramifications of Parliamentary procedure will not hold up the passing into law of a reasonable Bill for the development of aviation. The international side of this question will be awaited from Paris with considerable interest and possibly a little anxiety.

\- - -

AVIATION doth give us bold advertisement, and this no doubt is at the back of the head of Sir Woodman Burbidge, the very astute director of Harrods, Ltd., in letting it be known at this early date of his "booking" a passage by airship to Buenos Ayres next August, where he is due in connection with the offshoot in that city of the great Brompton Road emporium. By the usual sea route about three weeks is the time for the journey. Four days, it is calculated, will see Sir Woodman at his destination with the help of the airship.

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MR. BONAR LAW has already become quite acclimatised to his flights to Paris and back, in fact he seems quite *blasé*. He and his secretary, Mr. Davidson, are reported as being so much at home in the Handley-Page, that Mr. Law passes the time by reading, what time his secretary sits side by side with him in the roomy cabin.

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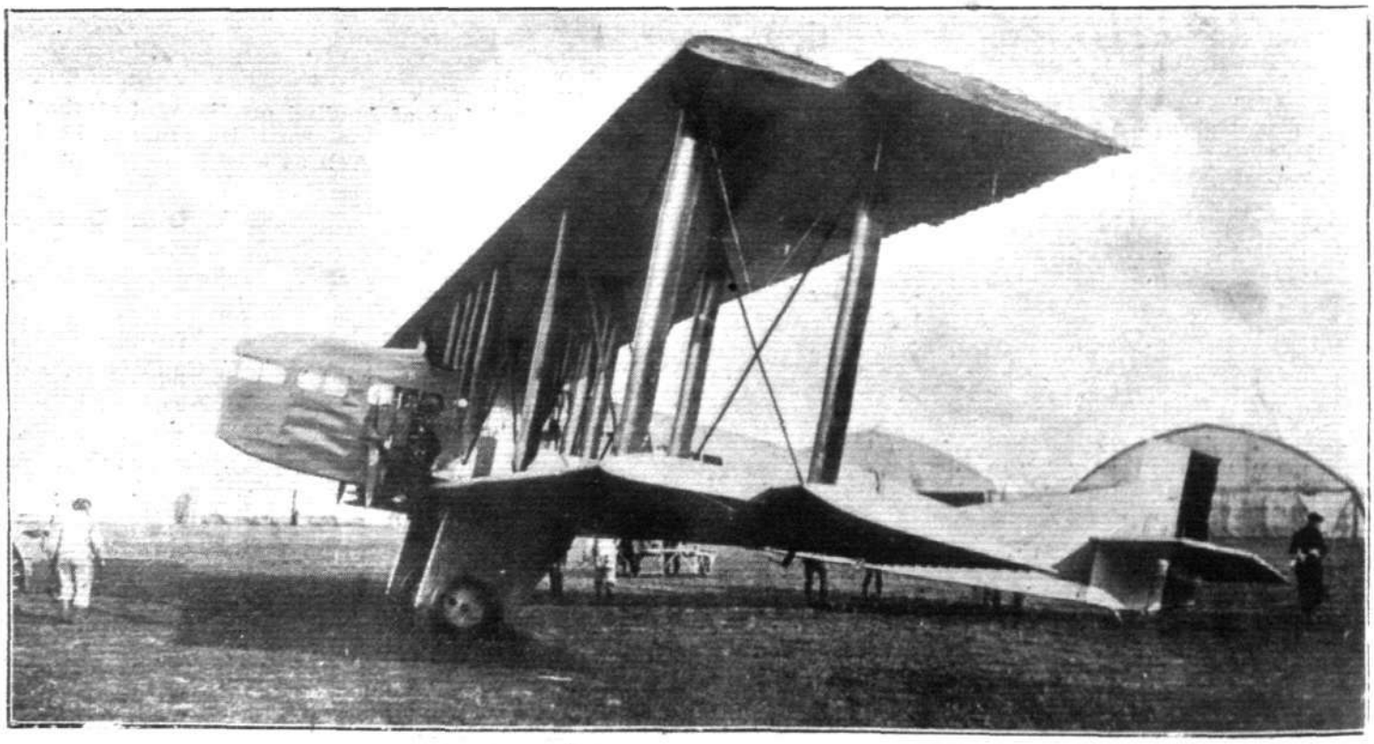
"WE ought to continue to manufacture aeroplanes in reasonable quantities, but more than that, we should develop



The big Farman Paris-England Service Aeroplane, with enclosed passenger cabin. Side view of the monster showing passengers' cabin in front. The machine has a span of 92 feet, and can lift three tons. The machine can climb 1,500 ft. in 4 mins., 3,000 ft. in 10 mins., and 6,000 ft. in 28 mins.

mechanical flight *so as to be able, should the emergency arise, to achieve supremacy of the air.* The air problem rests on effort and co-ordination. For that reason we should unify all air efforts in a single department." Thus Senator Chamberlain of Oregon, the chairman of the Senate Military Affairs Committee, who have recommended the establishment of a separate Bureau of the Air with its chief a Cabinet officer. Note the italics. And this when in Merrie England we are thinking of it as half a man's job.

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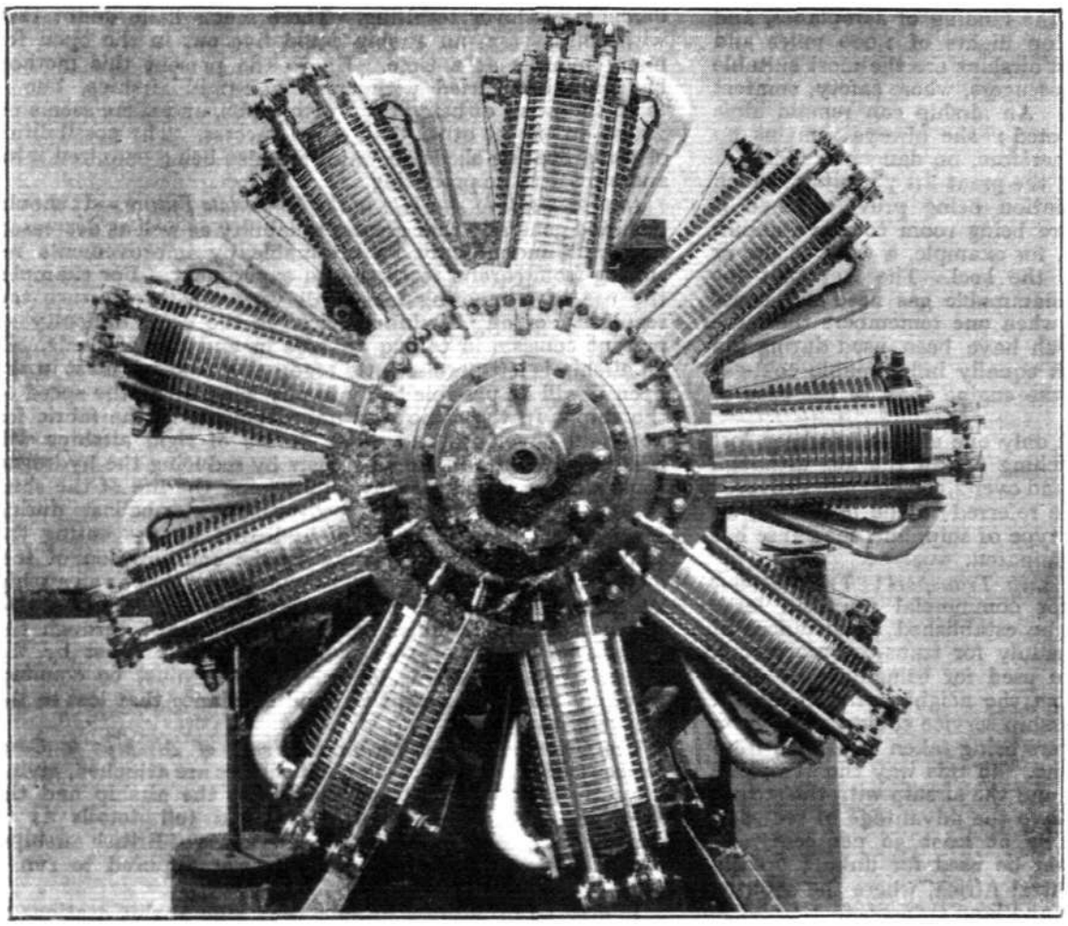
A NEW method of getting rid of rats has been brought to light through aviation. It is to be hoped our town and rural authorities will note and take full advantage of ridding the country of these noxious vermin. The novel method has been evolved during the journey of Major-Gen. Salmond and his party to India. On the arrival of the Handley-Page at Karachi the travellers, according to the *Pioneer Mail*, related the following story of an adventurous rat.



A B.R. 1 rotary engine, built by the Humber Works, Coventry. The B.R. type of rotary is of official design, and was at one time known as the Admiralty Rotary. There are two types, the B.R.1, of 150 h.p., and the B.R. 2, which develops 240 h.p.

The rat, attracted by the food supplies, boarded the aeroplane, it is believed, at Chabar, a previous stopping-place, or earlier. At all events, it was heard gnawing after leaving Chabar, and at Karachi the guard which protected the machine during the night heard the rat continuing its nibbling. The rat, however, could not be located or caught. After leaving Karachi its activities went on, and as it was thought it might be gnawing some important part of the machine, it was decided to see if cold would have any effect on its activities. The machine was accordingly taken to over 10,000 ft., and this was too much for a rat nurtured in the balmy warmth of the Persian Gulf, and, frozen or numbed with cold, it could apparently hold on no longer, and dropped off into space.

\- - -

NEXT, please !

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THERE is a certain kinship between official methods across the Channel and those of our own circumlocution offices. The Director of Aeronautics decided to put a group of aeroplanes at the disposal of the Minister of the Blockade and the Invaded Regions. After three days he managed to find out who was actually charged with the revictualling, and informed him of what was proposed. " Permit me to smile ! " said the official concerned, dubious exceedingly as to the utility of flying machines. The officer had to plead the cause of aviation, explaining the co-operation of the flyers with the revictualling services, the possibility of feeding small towns where railways were not, *et patati et patata*i At last he won his point, but his experience has ruAed him ; and he says expressively that while all this red-tape was being unravelled the inhabitants of the Eastern provinces could do naught but " clack their beaks ! "

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VEDRINES the incorrigible repeated his feat of landing on a roof later for the benefit of the cinema people, who took yards of film, precariously ensconsed on neighbouring chimneys. The machine was slightly damaged this time. The feat was performed with a little G-3 Caudron with a Gnome engine. Vedrines had several rehearsals on the ground before the attempt, and succeeded in pulling-up in a twenty-yard circle. There were difficulties with the unimaginative police. The pilot himself seemed to be a little doubtful as to the result, as he said to a friend that he did not know " whether to-night I sleep in my bed or in a box ! "

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A MILLION capital aeronautical " Milestone."—The Aviation and General Insurance Company, Ltd., has just been registered at Somerset House with a nominal capital of £1,000,000 in £1 shares, to carry on life assurance, annuity, deferred annuity, accident, sickness, employers' liability and fire insurance and other business, etc. £20,000 has been deposited with the Chancery Court in respect of life assurance and £20,000 in respect of employers' liability insurance, as required by statute. The two first share subscribers are Lord Furness and E. Furness, and the address of the new company is at 56, St. James Street.

* * * *

Br Aeroplane to Paris.

Lieut.-Colonel N. Arion, Military Attaché to the Roumanian Legation, and Head of the Roumanian Mission, left Hendon at nine on Tuesday morning by aeroplane for Paris. He carried nrgent and important despatches for the Roumanian Delegates attending the Peace Conference.

AIRSHIPS FOR COMMERCIAL PURPOSES

[*Officially issued by the Air Ministry.*]

The Relative Advantages of Airships and Aeroplanes

IN view of the different characteristics of airships and aeroplanes, it appears that the future uses of the two types for commercial purposes will not conflict. The airship is essentially a long-distance weight-carrying craft as compared with the short-distance high-speed aeroplane. It should be noted, however, that even in the matter of speed the airship of to-day with a speed of 77.6 m.p.h. can be considered slow only relatively to the aeroplane, as she is unquestionably fast in comparison with land and sea methods of transport. In addition to this the airship has the advantage of not being dependent upon her speed through the air for her ability to remain aloft, and is not, therefore, liable to forced descent in case of engine failure, as is the aeroplane. Quite large repairs to engines, such as the changing of a cylinder, are possible in an airship.

The airship, then, is worthy of consideration for commercial flights over sea or land of a wooded or broken nature, such as to be unsuitable for the landing of aeroplanes, and on journeys involving non-stop flights of 1,000 miles and upwards. In addition to this, airships are the most suitable aircraft for the carrying of passengers, where safety, comfort and reliability are essential.* An airship can remain aloft while engine repairs are effected; she always remains on an even keel, and there is, therefore, no danger in flying at night or in fog or clouds, and the great lift permits of much more comfortable accommodation being provided than is possible in an aeroplane, there being room to move about. In the case of a rigid airship, for example, a walk of 400 or 500 ft. may be taken along the keel. The fact that the envelope is filled with an inflammable gas need not cause any misgivings as to safety, when one remembers the large number of motor vehicles which have been used during the War carrying bags filled with equally inflammable coal-gas at no greater distance from the engine than in the case of an airship.

Official statistics show that only one airship has been lost in this country owing to catching fire in the air, although 83,360 hours have been flown and over 2,500,000 miles covered during the War. In the case referred to the flight was an experimental one with a new type of ship, and the cause has since been ascertained and eliminated.

Conditions favourable to Airship Transport: Trans-oceanic Services.—It appears that for commercial purposes large rigid airship stations should be established at distances of 2,000 to 3,000 miles apart, mainly for trans-oceanic traffic, while the aeroplane would be used for bringing passengers and merchandise to these from the neighbouring countries. For example, a continental airship service could be run from Lisbon to New York, passengers being taken to Lisbon from Paris, Rome, etc., by aeroplane. In this way the aeroplane would compete with the train and the airship with the steamship, over which she would have the advantage of reducing the average time of transit by at least 50 per cent. In addition to this airships would be used for linking up the railways in such places as Central Africa, where the country is difficult both for aeroplanes and land transport.

It is worthy of note that though airships are generally considered to be fair-weather craft, up to the end of November there were only nine days in 1918 when no airship flight took place in the British Isles—which are notorious for possessing almost the worst weather conditions of any country in the world. The airship is able to fly on days when fog or low-flying clouds are prevalent, which might be considered unsuitable for aeroplanes.

In long voyages, advantage could be taken of favourable winds and the routes chosen accordingly. Owing to her long endurance, an airship could afford, should a depression be met with, to fly either over or round it.

The latest German rigid airship has a disposable lift available for crew, fuel, merchandise, etc., of over 38 tons, which gives her a theoretical endurance (if all the available lift be employed in carrying petrol) of 177.5 hours (7 days) at a cruising speed of 45 m.p.h.—the maximum speed being 77.6 m.p.h.—during which 8,000 miles would be covered. A detailed statement of the "disposable lift" available for freight of each existing type of British airship showing the petrol consumption is attached. From these figures the freight which can be carried and the time taken over any given route can readily be worked out.

The Advantages of Mooring Out Airships: Cheap Housing and Independence of Weather.—It should be noted that for purposes of short distance pleasure trips from, for example, South Coast towns, it would not be necessary to establish large stations at each town, but the following principle, which has been found most economical and successful during the War, might be adopted. This consists of building a station provided with permanent sheds, quarters, etc., at some convenient centre, and forming temporary bases consisting merely of a small cheap portable shed and a few tents or huts at other places, from each of which one or two airships are run; main supplies being drawn from the "parent" station where all large repairs are effected. In addition to the use of portable sheds at sub-stations, experiments have been carried out in mooring out airships in the open, which have had such a large measure of success as to promise well for the future.

An airship has been successfully moored out for six weeks in a perfectly open expanse to a specially designed mast. Only two or three men are required to look after the ship, and winds of up to 52 m.p.h. have been ridden out without any damage whatever resulting. There seems little doubt that with this system an airship could live out in the open for many months at a time. Up to the present this method has only been tried with small non-rigid airships, but it is on the point of being tried with rigids, and there seems no reason to expect other than equal success. The possibilities of using floating sheds on water are also being enquired into, and appear to be promising.

Improvements to Airships in the Immediate Future.—It should be noted generally that greater reliability as well as decreased cost will undoubtedly be attainable by improvements resulting from careful research and experiment. For example, the use of a mooring mast will very greatly increase the regularity of any airship service, as the chief difficulty at present consists in taking airships in and out of sheds. If an airship is left permanently ready at a mooring mast in the open it will be possible to fly in any wind up to the speed of the ship. In the same way improvements in the fabric for non-rigid envelopes and outer covers of rigid airships will result in decrease in running costs by reducing the hydrogen consumption, and generally lengthening the life of the ship.

Similarly, a system of recovering water-ballast during flight would obviate waste of hydrogen by preventing the ship becoming "light," owing to the consumption of fuel during a long voyage. It will be understood that as an airship becomes light she tends to rise, which causes the hydrogen to expand, so that it must be allowed to escape through the automatic valves, or the gas-bags would be burst by the internal pressure. This tendency to rise must be counteracted by taking in weight to counterbalance that lost in the fuel consumed.

The Commercial and Technical Merits of Airships in Comparison with Aeroplanes.—Two appendices are attached, giving respectively a technical comparison of the airship and the aeroplane for long-distance flying, and full details as to performance, cost, etc., of the various types of British airships, showing an estimate of the man-power required to run a commercial airship service.

It may be of interest to note that nine airship stations of various sizes will in all probability shortly cease to be in use by the Admiralty. These will, therefore, become available for commercial purposes, though the greater part of the ground is occupied under the Defence of the Realm Act. In addition a certain number of S.S. Zero airships and costal star airships will become available for disposal.

APPENDIX A

The Development and Potentialities of Rigid Airships and Aeroplanes

I. *Foreword.*—During the last four years sufficient experience has be n obtained in the construction and use of rigid airships to enable future developments to be forecasted with some assurance of accuracy; and it is, therefore, possible to consider the lines along which progress should be sought, and the performances which, within the next few years, can be obtained from rigid airships. In view of the widely-held opinion that the development of the large aeroplane will ultimately kill the large airship, it is necessary to institute a comparison between the future possibilities of both types. The result shows that in each case certain inherent qualities govern progress, and that these qualities, being widely different, will cause the two types to cover different fields of utility. It appears also that, whereas increase in size of aeroplanes brings many difficulties in its train with no compensating improvement in efficiency, increase in size of airships results in a reduction of the difficulties experienced at present, and

* *Vide* Report of Civil Aerial Transport Committee.

gives improved efficiency, thereby opening up future possibilities of extraordinary value.

II. *Progress in Heavier-than-Air and Lighter-than-Air Machines*: 1914—1918.—The development of rigid airships has been even more rapid than that of aeroplanes. In 1914, the average endurance of a German rigid at cruising speed was under one day, and the maximum full speed about 50 m.p.h. In 1918 (German L. 70 class, 2,195,000 cub. ft. capacity), the endurance at 45 m.p.h. has risen to 177.5 hours (7.4 days) and the maximum full speed to 77 m.p.h. The ceiling has correspondingly increased from 6,000 ft. to 23,000 ft. The British R. 38 class (2,720,000 cub. ft. capacity) has an estimated cruising endurance at 45 m.p.h. of 211 hours (8.8 days), 34 hours greater than the German L. 70 class. It is a matter of some difficulty to make a fair and at the same time simple comparison between two types of transport possessing widely different qualities. The figures for rigids are comparatively simple, as they are few in number and all of approximately the same class, compared to the many different classes of H/A machine which have been developed for various purposes. The Avro has been taken as the best all-round machine actually in use in August, 1914; large machines such as the Sikorski, the Caproni, and the Graham White five-seater, were then only in the experimental stage, and, besides, did not possess the all-round efficiency of the Avro. The D.H. 10a has likewise been taken as the best all-round machine in August, 1918. Although the two-engined Handley-Page and Caproni have greater endurance and weight-carrying capacity, their all-round efficiency appears inferior to the D.H. 10a. The Handley-Page V. gives promise of having a slightly better performance than the D.H.10a, but this machine is still in the experimental stage, and reliable performance figures are not available.

Tables 1 and 2 give the progress in L/A and H/A since 1914. Table 3 shows the difference in performance between corresponding L/A and H/A craft of 1918.

TABLE 1. L/A

August, 1914	Average figure for German Naval Zepp.	August, 1918. German L.70.	Progress. Per cent.
Maximum speed at 10,000 ft.	50 m.p.h.	77.6 m.p.h.	55
Endurance at 45 m.p.h.	20 hours	177.5 hours (7.4 days)	787.5
Total lift	30 tons	66.64 tons	122
Disposable lift	8.5 tons	38.84 tons	357
Efficiency ratio	27.3 per cent.	58.3 per cent.	113.5
Static ceiling	6,000 ft.	21,000 ft.	250
Indicated h.p.	800	2,100	162.5

TABLE 2. H/A

August, 1914.	Avro.	August, 1918. D.H.10a.	Progress.
Speed at 10,000 ft. ..	70 m.p.h.	125 m.p.h.	78.3
Endurance	4 hours	10 hours	150
Total weight loaded ..	.737 tons	4.02 tons	455
Useful load	.268 tons	1.45 tons	445
Efficiency ratio	36.6 per cent.	36.1 per cent.	0.55 (Decrease)
Ceiling	14,000 ft.	22,500 ft.	35.7
Indicated h.p.	80	810	913 per cent.

August, 1914.	Avro.	August, 1918. Handley-Page.	Progress. Per cent.
Speed at 10,000 ft. ..	70 m.p.h.	85 m.p.h.	21.4
Endurance	4 hours	12.5 hours	212.5
Total weight loaded ..	.737 tons	5.97 tons	524
Useful load	.268 tons	2.17 tons	709
Efficiency ratio	36.3 per cent.	36.4 per cent.	0.28
Ceiling	14,000 ft.	15,000 ft.	7.1
Indicated h.p.	80	720	800

TABLE 3. COMPARISON OF EXISTING H/A AND L/A MACHINES

August, 1918.	H/A D.H.10a.	L/A German L.70.	Percentage Superiority. Per cent.
Speed at 10,000 ft.	125 m.p.h.	77.6 m.p.h.	H/A 61.1
Cruising endurance	14 hours	177.5 hours	L/A 1167
Total lift (= weight loaded)	4.02 tons	66.64 tons	L/A 1557
Disposal lift (= useful load) ..	1.45 tons	38.84 tons	L/A 2580
Efficiency ratio ..	36.1 per cent.	58.3 per cent.	L/A 61.5
Ceiling	19,000 ft.	21,000 ft.	L/A 10.5
Indicated h.p. ..	810	2,100	L/A 159

It will be seen that at the present time the largest rigids in commission have over 10 times the total lift of the corresponding H/A, and that the disposable lift is about 25 times greater. The proportion of useful lift compared to gross lift is much higher in airships than in aeroplanes. An approximate figure for an aeroplane of average engine power is one-third, while in a rigid the useful life available for fuel, crew, passengers, freight, etc., is well over one-half. In the case of L.70 the figure is 58.3 per cent., although this ship is the most heavily-engined and fastest airship yet built. It cannot be too strongly emphasised that many of the advantages apparently possessed by H/A at the present time result from their relatively small lift. Thus, an aeroplane of 60 tons total lift, if found to be possible at all, would certainly be very much less convenient to land and handle on the ground than aeroplanes of existing sizes, and would require overall dimensions about twice those of the largest existing machines.

III. *Technical Advantages in the Design of Airships.*—Improvements in design, materials, machinery, etc., may be expected to produce great advances both in H/A and in L/A. It may be assumed also that most of the difficulties now experienced, such as the landing of large H/A and the handling of large L/A upon the ground, will be overcome by various means to a similar extent, and that the general utility of both types will enormously increase.

Increase in Size Unfavourable to Aeroplanes.—It is important to note that in H/A there is no automatic improvement in efficiency resulting from greater dimensions. In L/A, on the other hand, such an automatic improvement takes place to a very marked degree. The reason for this difference is as follows:—In similar H/A machines of different dimenions, the total lift, air resistance, and b.h.p.—other things being equal—all vary nearly as the plane areas, *i.e.*, as the square of the linear dimensions.

It follows that the ratio $\frac{\text{weight of machinery}}{\text{total lift}}$ does not vary much with size of machine. The ratio $\frac{\text{weight of structure}}{\text{total lift}}$ tends to increase with size of machine. Unit area of wing surface can only exert a definite lifting effect, and as the machine increases in size it is necessary to increase proportionally the weight of each preceding unit area of wing surface to make the machine proportionally strong. A point is finally reached where every additional unit of wing surface results in as much increased weight as its lifting effect, so that any further increase in size will involve a definite falling off in the total lifting capacity of the machine. A further small increase in size can be effected by increasing the number of planes; but, owing to the inefficiency of middle plane surfaces, due to the blanketing effect of the top and bottom planes, the resulting gain in endurance will not be large, and it will only be effected at the price of a loss in efficiency.

As the relation of size to performance is one of the governing factors in future development, it is considered from another point of view:

In all similar structures the strength of the given structure is inversely proportional to its linear dimensions. This general property of structure applies both to airships and aeroplanes, but gives a very different numerical value in the two cases. In aeroplanes, if a given wing area in a small aeroplane weights x lbs. for a span of y feet, then to double the span and still maintain the structure proportionately strong the weight of the second structure will be $2(x + x) = 4x$; and if the width (chord) of the wing structure be correspondingly doubled, the weight of the struture will equal $8x$. Now the lift of the structure is directly proportional to the area, and if the span and chord are doubled, the area, and likewise the lift, will be four times as great, whereas the weight of the structure will be eight times as great to be correspondingly strong.

This unfortunate property of structure applies equally to airships; but the airship depends for its lift on *volume* (y^3), while the aeroplane depends for its lift on *area* (y^2). To give a concrete airship example, a 10,000,000 cub. ft. capacity rigid has five times the lift of the present 2,000,000 cub. ft. capacity rigid, but the length of the former is only 1.7 times greater, and therefore the weight of the structure only five times greater $(1.7)^3$—*i.e.*, the weight of the structure is directly proportional to the total lift.

This theoretical property of structure may, to a certain extent, be modified by the material used. Thus, in aeroplanes, there is a certain size of machine which can be built most economically of wood. Any machine of smaller or larger size entails a certain proportion of uneconomical weight, due to the inherent qualities of the material. This question of material applies equally to rigids; thus, for ships of 2,000,000 to 4,000,000 cub. ft. capacity, duralumin is the

most suitable material for the hull structure, while for ships of 8,000,000 to 10,000,000 cub. ft. capacity a saving in weight can be effected by the use of steel. In H/A machines, therefore, all round efficiency, as measured by the ratio of $\frac{\text{disposable lift}}{\text{total lift}}$ tends to decrease with greater dimensions. Greater efficiency will, therefore, not result from increase in size, but, on the contrary, great increase in size will not be attainable until greater efficiency has been first obtained by progress in design and materials. In other words, increase in size in H/A craft will be the result and not the cause of increased efficiency.

The Benefits resulting from the Increase in Size of Airships.—In L/A the total lift varies as the cube of the linear dimensions, while the air resistance and b.h.p.—other things being equal—vary as the square of the linear dimensions. Hence the ratio $\frac{\text{weight of machinery}}{\text{total lift}}$ decreases automatically. Values for this " coefficient of tractive resistance " for airships are given in Table 4.

TABLE 4.

Gross Lift of Rigid.	Coefficient of Tractive Resistance at 45 m.p.h. Per cent.	60 m.p.h. Per cent.	80 m.p.h. Per cent.
60 tons	1.9	3.8	7.7
80 tons	1.7	3.4	6.7
100 tons	1.5	3.0	6.0
150 tons	1.3	2.5	5.0
200 tons	1.1	2.2	4.4
250 tons	1.0	2.0	4.0
300 tons	0.9	1.8	3.6

It will be seen that they vary from .9 per cent. for a large rigid at 45 m.p.h. to 7.7 per cent. for a small rigid at 80 m.p.h., compared with 15 per cent., which may be taken as an average figure for H/A craft. It will further be seen that as the size of the rigid increases, the coefficient of tractive resistance decreases to a marked extent. With a proportionate increase in horse-power, it is easier and proportionately more economical for a 10,000,000 cub. ft. capacity rigid to fly at 80 m.p.h. than for a 2,000,000 cub. ft. capacity rigid to fly at 60 m.p.h. In the case of H/A craft, however, increase in size effects no decrease in the coefficient of tractive resistance.

The figures for tractive resistance are based on the German L.33 steamline form, and from the experimental results already obtained by the National Physical Laboratory at Teddington, it is reasonably certain that a more efficient streamline form can be obtained which will appreciably reduce these figures. As the ratio $\frac{\text{weight of structure}}{\text{total lift}}$ is, in airships, fairly constant, it follows that the ratio $\frac{\text{disposable lift}}{\text{total lift}}$ increases with dimensions. The natural tendency will therefore be towards larger airships, in order to secure the benefit of the resulting gain in efficiency.

A further point of great importance emerges from the above. As the total lift varies as (dimensions)^2 in H/A, and as (dimensions)^3 in L/A, increase in total lift is secured in the latter with less increase in dimensions than in the former. Thus, to secure five times the total lift, we must increase the dimensions 124 per cent. in H/A and only 70 per cent. in L/A. If total lift is increased indefinitely in both types, the dimensions of the H/A will, therefore, ultimately pass those of L/A, when almost the last remaining advantage of the former over the latter will disappear.

The proportion of useful lift compared to gross lift is much higher in airships than in aeroplanes. An approximate figure for an aeroplane of average engine power is 33 per cent., while in a rigid the useful lift available for fuel, crew, passengers, freight, etc., is well over 50 per cent. In the case of the German L.70 the figure is 58.3 per cent., as has already been mentioned.

Conclusions as to the Future Development and Use of H/A and L/A Machines.—From the above considerations, it is concluded that in H/A increase in size without loss in efficiency must result from, and be limited by, the extent of improvements in design, etc. The tendency will, therefore, be to confine aeroplanes to moderate dimensions, except where large size is rendered necessary by the need of reducing the number of units employed upon a particular service, or by other causes such as where long-distance non-stop flights are necessary. The outstanding characteristics of H/A will, therefore, remain as at present: high speed, handiness, moderate lift, independence of all weather conditions except the worst. As regards L/A, the functions now performed by the smaller airships will be usurped more and more by H/A. Airships may be expected to develop in the direction of increased size to a limit which is not yet in view. The outstanding characteristics of L/A will be reasonably high speed, very long endurance, great weight-carrying capacity for freight, stores, passengers, etc.

The practical range of all types of aircraft carrying mails, passengers, or merchandise, will be small compared with their maximum range given in these notes, which is calculated for calm air, and assumes, besides, that all the disposable lift (useful load) aside from crew, food, emergency water ballast, etc., is available for fuel. For transport purposes, allowance must be made for the commercial load and additional fuel over and above that actually required for the given flight, which must always be carried in case unfavourable weather is encountered. Actually, the practical range will not be much more than one-fourth of the maximum range.

Summarising, therefore, it would appear that the line of policy to be adopted is to develop the aeroplane for transport over distances under, say, 500–800 miles, and the rigid airship for trans-oceanic and possibly trans-continental flights of over this length.

IV. *Large Airships.*—It is now proposed to consider more fully the possibilities of the large airship. Table 5 shows the approximate dimensions of a series of airships similar in form to R.33.

TABLE 5

Capacity in cub. ft.	Gross lift in tons.	Length. Ft.	Diameter. Ft.
2,000,000	60.7	643	79
3,000,000	91.1	736	90.4
4,000,000	121.4	810	99.5
5,000,000	151.8	872	107.2
6,000,000	182.2	927	113.9
7,000,000	212.5	976	119.9
8,000,000	242.8	1,021	125.4
9,000,000	273.3	1,061	130.4
10,000,000	303.6	1,100	135.1

It will be seen that although a 10,000,000 cub. ft. capacity rigid has five times the gross lift, and over five times the disposable lift of the present 2,000,000 cub. ft. capacity rigid, the dimensions of the large ship are only 1.7 times greater, and it could be docked in a shed of no more than one-third larger dimensions than those at Killeagh, *i.e.*, 1,150 ft. long by 160 ft. high by 180 ft. wide, compared with 850 ft. long by 130 ft. high by 150 ft. wide for Killeagh.

As regards constructional sheds, the most economical method of accommodating such large airships would perhaps be to lengthen existing constructional sheds, which are sufficiently wide, to at least 1,150 ft. long (present length 700 ft.), and lower the floors as necessary to secure the required height. A somewhat similar course could probably be taken with existing housing sheds.

To obtain a reasonable performance with a small ship, every effort has to be made to save weight, and complicated built up girders must be used owing to their property of forming a light and strong joint. In a large ship, owing to the increase in efficiency with size, it would be possible to sacrifice a certain amount of lightness in construction for the sake of simplicity in design. With increase in size, steel could be used with advantage in place of duralumin, and a great saving in cost effected thereby. With increase in size, too, it should be possible to produce a rigid of so much more rugged construction that it might even be erected in some form of roofless dock, remain either moored out or in flight while in commission, and only return to dock for a complete refit, thus saving much of the expense of housing stations. Just as with H/A craft, where aeroplanes have gradually increased in size, checked and modified in each successive stage by the results obtained under Service conditions; so the construction of the really large rigid must be approached systematically, in successive stages, checked and modified at each stage by practical results.

Bad weather will not appreciably endanger a rigid in flight, and its chief operational handicap has so far been the probability that it will sooner or later be caught out in a high wind lasting for a longer period than the endurance of the ship, so that the ship would then have to attempt to land before the wind dropped and would probably be wrecked. If the meteorological reports for previous years are examined, it will be seen that even under unfavourable conditions it will be possible for a ship with a three weeks' endurance to leave the shed during any temporary lull in the wind, carry out a fortnight's flight, and calculate on being able to return and land during another lull in the ensuing week. Should the large ship meet a storm, she will be able to go round or over it, and could afford to wait in the air for fine weather in which to land. Thus, if the endurance of a rigid is increased to a sufficient extent, it will be possible to carry out flights with a regularity comparable to that maintained by surface craft.

The range, practically speaking, is almost unlimited, and the weight carrying capacity large. A 10,000,000 cub. ft. capacity rigid will have a disposable lift of over 200 tons, which is available for petrol, ballast, crew, passengers, freight, in varying proportions as desirable. The uses to which such an airship could be put are clearly of great importance. Further, there is no other type of vessel which could as efficiently undertake them.

With a rigid of about 10,000,000 cub. ft. capacity, and endurance of approximately three weeks at 40 to 45 m.p.h., with a maximum speed of 70 to 80 m.p.h., a ceiling of some 30,000 ft. can be obtained, and a maximum range of over 20,000 miles, or nearly once round the world. This colossal endurance and range of action can be achieved in large rigids because, contrary to H/A, the characteristics of L/A are governed by two factors :—

1. The lift of a rigid is proportional to its cubic capacity (dimensions)^3.

2. All fuel carried is used for forward propulsion and not, as in the case of H/A craft, chiefly for maintaining the structure in the air, the head resistance of the airship being small compared to that of an aeroplane of the same lift.

Characteristics of Non-Rigid Ships

Dimensions

	Length ft.	in.	Width ft.	in.	Height ft.	in.	Capacity
S.S.Z.	143	0	32	0	46	0	70,000
S.S.T.	165	0	35	6	49	0	100,000
C. Star	218	0	49	3	57	6	200,000
N.S.	262	0	56	9	69	3	360,000

Performance

	S.S.Z.	S.S.T. (100,000 c.f.)	C. Star.	N.S.
Gross lift in lbs.	4,900	7,000	14,500	24,300
Disposable lift = Gross lift, less weight of airship empty, *i.e.*, without crew, petrol, oil and ballast on board lbs.	1,850	2,200	4,850	8,500
Crew No.	3	4	5	10
	480	640	800	1,600
Available lift for fuel and freight lbs.	1,370	1,560	4,050	6,900
Petrol consumption (full speed)—				
Lbs./hour	49	100	224	312
Galls./hour	6.7	13	30	42
Oil consumption (full speed)—				
Lbs./hour	3.6	7.2	18.4	29.8
Galls./hour	.36	.72	2.05	3
Full speed	42 knots	50 knots	50 knots	50 knots
m.p.h.	(48.37)	(57.5)	(57.5)	(57.5)
Cruising speed	30 knots	37 knots	35 knots	37 knots
m.p.h.	(34.5)	(42.6)	(40.3)	(42.6)
Running costs of hydrogen (per hour)	5*s.*	7*s.* 6*d.*	£1	£1 10*s.* 6*d.*
Engines h.p.	1-75	2-75	For'd 1-110; Aft. 1-260	2-260

Upkeep.—Cost

S.S.Z., £5,000 ; S.S.T., £8,200 ; C. Star, £12,750 ; N.S., £24,000. Less 40 per cent. reduction for peace-time figures.

20 per cent. of the capital outlay on non-rigid airships is considered sufficient allowance for all spare parts, envelopes, etc., required in the course of a year. This figure would keep an airship in an efficient condition, and provide for the rebuilding in case of an accident.

Characteristics of Rigid Airships

Dimensions and Cost

Type	Overall Length Ft.	Overall Width (Diameter). Ft.	Overall Height Ft.	Cost £
2,000,000 ship (approx.)*	693	79	92	150,000
10,000,000 ship (approx.)	1,100	135	150	200,000 to 300,000

Performance

	2,000,000 Ship*	10,000,000 Ship†
Gross lift	66.6 tons	303.6 tons
Disposable lift	38.8 tons	200 tons (approx.)
Allowance for crew, water ballast, etc.	11 tons	30 tons
Available lift for fuel and freight	27.8 tons	170 tons
Full speed (10 per cent. less than full power)	64.3 kts. (74 m.p.h.) 1,800 h.p.	75 kts. (86.3 m.p.h.) 6,000 h.p.
Petrol consumption/hour	972 lbs. (135 galls.)	3,240 lbs. (450 galls.)
Oil consumption/hr.	97 lbs. (11 galls.)	324 lbs. (36 galls.)
Cruising Speed, fast	43 kts. (51.8 m.p.h.) 790 h.p.	60 kts. (69 m.p.h.) 3,700 h.p.
Petrol consumption/hour	427 lbs. (59 galls.)	2,000 lbs. (278 galls.)
Oil consumption/hr.	43 lbs. (5 galls.)	200 lbs. (22 galls.)
Cruising speed, slow	40 kts. (46 m.p.h.) 610 h.p.	45 kts. (51.8 m.p.h.) 1,800 h.p.
Petrol consumption/hour	327 lbs. (45 galls.)	927 lbs. (135 galls.)
Oil consumption/hr.	33 lbs. (4 galls.)	97 lbs. (11 galls.)
Running Cost of Hydrogen/hour	£3	£6

* The figures for the 2,000,000 ship are based on L.70.
† Estimated.

7 per cent. of the capital value of a rigid airship is considered sufficient allowance for all spare parts required in the course of a year. This figure would keep an airship in an efficient condition and provide for repair in case of damage.

Capital Outlay for Airship Stations

Rigid

	£
Shed, 750 ft. long, to house two rigids	300,000
Gas plant and buildings	75,000
Quarters and subsidiary buildings	10,000
Roads, drainage, railway and water supply	81,400
	466,400
Less 40 per cent. increase expenditure on account of war prices	186,560
	279,840

Non-Rigid

	£
Shed, 350 ft. long, to house four S.S.T. or two C. Star or one N.S.	103,000
Gas plant and buildings	40,000
Quarters and subsidiary buildings	2,500
Roads, drainage, railway and water supply	58,600
	204,100
Less 40 per cent. increase expenditure on account of war prices	81,640
	122,460

Non-Rigid Temporary Base

	£
Cost of portable shed to house one S.S. twin airship	7,500
Quarters and subsidiary buildings to house 100 men	1,500
	9,000
Less 40 per cent. increase expenditure on account of war prices	3,600
	5,400

(In this case gas would be supplied from the " parent " station.)

Particulars of the Personnel Required

TABLE A.—*Complements for Airship Stations*

Trade Classification.	Four S.S. Twin, or two C. Star, or one N.S.	Two Rigids.
Fitters	3	6
Turners	2	4
Sheet metal workers	1	6
Blacksmiths	1	2
Welders	1	2
Mechanics	8	20
Power engineers	2	4
Electricians	3	5
Carpenters	8	20
Propeller repairers	2	4
Woodwork machinists	1	2
Painters	1	2
Riggers and fabric workers	9	26
W/T	3	6
Hydrogen workers	6	52
Meteorological	3	3
Stores	3	11

Drivers	5	15
Plumbers	1	2
Vulcanisers	1	2
Coxswains	1	1
Engineer draughtsmen	1	2
	72	195
Unskilled labour	40	200
	112	395

In addition, the crews and attached party for each type of ship should be added to these figures. (See Table B).

The following officials are also required :—

Manager and Secretary, Landing Official, Engineer, Electrical and W/T, Hydrogen, Meteorological and Stores and Accountant.

TABLE B.—*Crews and Extra Station Personnel for Airships.*

Allowance for one S.S.Z.—1½ *Officers*, 10 *Men.*—*Crew* : Coxswain, 1 ; engineer, 1 ; W/T, 1. Total 3. *Attached Party* : Riggers, 2 ; engineer, 1 ; carpenter, 1 ; working party, 3. Total 7. *Officers* : Three for every two ships.

Allowance for one Coastal—1½ *Officers*, 16 *Men.*—*Crew* : Coxswains, 2 ; engineer, 1 ; W/T. 1. Total 4. *Attached Party* : Riggers, 3 ; engineers, 2 ; carpenter, 1 ; working party, 6. Total 12. *Officers* : Three for every two ships.

Allowance for one N.S.—3 *Officers*, 28 *Men.*—*Crew* : Coxswains, 2 ; riggers, 2 ; engineers, 3 ; W/T, 2. Total 9. *Attached Party* : Riggers, 6 ; engineers, 3 ; carpenter, 1 ; working party, 9. Total 19. *Officers* : One captain, one first officer, one spare pilot.

Allowance for one Rigid—6 *Officers*, 60 *Men.*—*Crew* : Coxswains, 2 ; riggers, 8 ; engineers, 13 ; W/T, 3. Total 26. *Attached Party* : Riggers, 12 ; engineers, 13 ; carpenter, 1 ; writer, 1 ; storekeeper, 1 ; working party, 6. Total 34. *Officers* : One captain, one first officer, one second officer one engineer officer, two spare pilots.

NOTE.—Attached parties do not go up in the air with the airship.)

ESTIMATED WAGES AND SALARIES.

Small Station (*Four S.S.T. or Two C. Star. or One N.S.*)

Manager and secretary, £600 ; landing official, £500 ; engineer official, £350 ; electrical and W/T, £250 ; hydrogen, £250 ; meteorological, £250 ; stores and accountant, £200. Total £2,400.

			£		
Pilots (4 S.S.T.), six at £400 per annum			2,400	Table	B.*
Crews (4 S.S.T.) .. 40				,,	B.*
Skilled labour at £3 per week 72					
	112	..	17,472	,,	A.
Unskilled labour at 30s. per week ..	40	..	3,120	,,	A.
			£25,392		

Large Station (2 *Rigids*).

Manager and secretary, £800 ; landing official, £600 ; engineer official, £500 ; electrical and W/T, £300 ; hydrogen, £400 ; meteorological, £300 ; stores and accountant, £250. Total £3,150.

Pilots, 12			4,800	Table	B.†
Crews, 2 ships .. 120				,,	B.†
Skilled labour at £3 per week 195					
	315	..	49,140	,,	A.
Unskilled labour at 30s. per week ..	200	..	15,600	,,	A.
			£72,690		

APPENDIX B

The Commercial Considerations Relating to Airships

General Notes

Sheds, Station Buildings, Etc.—The figures shown for the capital outlay on a station are based on war prices, and it is therefore difficult to give a reliable estimate, but a reduction of 40 per cent. is considered probable when normal conditions return. One large shed to house two rigid airships or a number of small airships is more economical from every point of view than providing a smaller shed to house single airships, unless the principle of having one large shed as the permanent station with a number of portable sheds or mooring masts at convenient distances apart is adopted.

Dimensions and Performance of Airships.—The lift available for fuel and freight is shown in order that the weight of passengers, merchandise, etc., that can be carried for any distance required, may be calculated. It should be observed that the speed of each type of airship is shown alternatively in miles and knots. One knot or nautical mile = 2,025 yards. Sixty nautical miles = 69.1 British statute miles.

Complement of Stations.—The number of men required to form the complement of a station without allowing for the crews and attached party of any particular type of airship, is shown in Table A ; to these figures shuld be added the crews and attached parties shown in Table B. The total complement for a station housing four S.S. twin airships or a two rigid airship station is shown.

Wages and Salaries.—The figures shown can only be regarded as a fair average, and in addition, it is thought that housing accommodation on model village lines will have to be provided, as it is essential to have workmen close at hand.

Fuel Costs.—Petrol and oil prices are not quoted, as these will vary considerably according to the supply and demand at any given time.

Hydrogen.—Contractors charge 10s. per 1,000 cub. ft., but with the latest gas producing plants installed at airship stations it is anticipated that 5s. per 1,000 cub. ft. will be the average cost, and therefore the estimates have been based on this figure. It appears probable, however, that this figure will be reduced as the uses of hydrogen for commercial purposes develop.

Explanatory Notes on Rigid Airship Data.

General—The figures for the 2,000,000 cub. ft. airship are based on the German L.70 class of rigid airship, though the actual capacity of this type is 2,195,000 cub. ft. The dimensions, horse-power and fuel consumption of the 10,000,000 cub. ft. ship may be taken as approximately correct, as it is possible to calculate these with considerable accuracy on the assumption that the streamline shape will be similar to that of L.70. The remaining figures for this class of ship are rather estimates than calculations, though they may all be accepted as on the moderate side. They are based on the assumption that increase in size is accompanied by certain advantages from the design standpoint, in addition to the prospect of proportionate improvements in methods of design resulting from experience such as has been obtained in the past.

Speed.—In all mechanical devices the general everyday performance is found to be below the standard of trial results, and the airship is no exception to this. While, therefore, there is little difference in effect on an airship between proceeding at "cruising speed" and at "full speed," considerably increased depreciation on the airship and power units and increased strain on the personnel result from driving the ship above "full speed" to the "absolute maximum speed" with the engines developing full power. The "full speed" therefore represents the constant speed which can be maintained on a flight lasting for the total petrol capacity of the ship, and is 10 per cent. less than the absolute full power which the engines can develop. However, for short distances, up to 800 miles or so, the absolute maximum speed could be maintained if required. Of the two cruising speeds given, "fast" represents the highest economic cruising speed in view of petrol consumption, etc., while the slower speed is the lowest speed which appears possible for commercial purposes having regard to existing means of transport, the effect of wind, etc. In areas where high speed is not of great importance the slower cruising speed could be adopted and a large economy in fuel obtained, resulting in the carrying of more cargo. In regions where the weather conditions vary considerably according to the season of the year, it should be possible, by taking advantage of prevailing winds, to maintain a standard ground speed at all seasons. In this way the airships could be run to scheduled time and the ratio of fuel to cargo weights adjusted according to the time of year.

Cost of Hydrogen.—In the case of the 2,000,000 cub. ft. ship the figure of £3 per hour can be taken as accurate (at the present price of hydrogen—5s. per 1,000 cub. ft.), as it is calculated from the performance of a British rigid airship of about 1¼ million cubit foot capacity over a period of three months, during which a large amount of flying was carried out. The figure for the 10,000,000 cub. ft. ship is more of a rough estimate, but may be taken as a fair figure, subject to reduction if a satisfactory system of water-ballast recovery is evolved. It may be remarked that with increase in size the *proportionate* consumption of hydrogen is reduced, for a variety of reasons.

Cost of Upkeep.—This covers all replacements rendered necessary by ordinary wear and tear, and also allows for small accidents such as do not involve total loss, or writing off of the ship. During a period of considerable flying activity the same airship as is quoted above in connection with hydrogen costs, only required one small engine replacement and a slight hull repair, totalling under £100. As size increases, the number of small repairs necessary will diminish, as large airships will be of more rugged construction.

* Pilots and crews according to type of ship.
† 3 at £600, 3 at £450, 3 at £250, 3 at £200.

FLIGHT
AIRCRAFT

AVIATION AND METEOROLOGY

THE importance of a proper meteorological service to aviation was emphasised by Colonel H. G. Lyons, R.E., D.Sc., F.R.S., acting director, Meteorological Office, in a paper read at the Royal Society of Arts on "Meteorology During and After the War."

Full advantage should be taken, he said, of the experience which had been gained by naval and military officers during the War to meet, as adequately as possible, those demands which would be made upon meteorology in the general reconstruction which was now beginning. On the outbreak of war meteorologists were at first considerably handicapped by the reduction of their supply of information; but this was soon rectified, and daily weather reports were again prepared, though lacking part of the Continental information. As time went on a far more extensive daily weather map was provided than in times of peace, from which it was possible to deduce, often with much accuracy, the weather conditions over Central Europe, and to supply reports of the general conditions, and the direction in which they were likely to develop, to the meteorological officers on the different fronts and to other offices and departments requiring the information. Observations were specially made for the use of airmen in preparing plans for the day's operations.

Precautions were taken to prevent information reaching the Central Empires, and the impression was that little, if any, was obtained from our area. Many cases could be cited where operations were undertaken by the enemy which it seemed very unlikely that he would have undertaken had he possessed the information which we had here. One, however, might be mentioned. On February 17, 1915, the conditions over the British Isles were apparently considered favourable by the enemy meteorologists, for Zeppelins crossed the North Sea for the East Coast of Great Britain. Before mid-day, however, a deep and rapidly moving depression had appeared off the coast of Ireland and moved rapidly eastward, resulting in the loss of two Zeppelins off the coast of Denmark.

More detailed information than was furnished by general forecasts was, however, required by the Royal Flying Corps and the Special Brigade, R.E. (Chemical Warfare), and steps were taken to supply it. Thus, under the new conditions of modern warfare, the single State service of pre-War days was supplemented by a Naval meteorological service, which provided meteorological officers and *personnel* for the Naval airship stations, and by an Army service which furnished the meteorological staff in each area of military operations. Frequent mention has been made during the war of the meteorological efficiency of the enemy's organisation, but he did not believe that they attained a higher standard than our own.

There were now four State meteorological services in operation—the Meteorological Office; the Meteorological Section, R.E., for the Army; the Meteorological Service, R.A.F. and the Air Ministry; and the Admiralty Meteorological Service. The relations and the means for co-operation between these four services would have to be worked out, and a number of considerations would have to be taken into account. Aviation with its prospect of long-distance communication, had rendered necessary a readjustment of meteorological relations within the Empire. There were about a thousand observation stations at present, and the great majority could without difficulty be developed so as to co-operate effectively in the meteorological organisation of the Empire. From the organisation necessary for Imperial co-operation to that of International co-operation was but a step, and we might look with confidence to even greater progress in the future The air routes of aerial transport would have to be studied, and all the information now available investigated and put in the form most suitable for airmen. While overland observations were numerous, our knowledge of the atmosphere over the sea was much less complete. By ships equipped for the purpose such observations could be and had been made in certain parts, but this line of investigation must be extended if our knowledge was to be adequate.

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CORRESPONDENCE

R.A.F. Pilots and Post-War Flying

[1973] There are a large number of pilots in the R.A.F. at the present moment who propose taking up civil flying after the War. They are, however, in a very difficult and uncertain position. The demand for pilots for civilian flying will not exist to any great extent for some time to come, probably from nine months to two years. If these pilots are demobilised when demobilisation takes place as is anticipated, they will have no means of keeping up their flying practice, and when eventually required for civil flying will be practically useless. On the other hand, if these pilots desire to continue flying until actually required for civil flying it appears that the only course open to them is to apply for a permanent commission in the Royal Air Force. If they adopt this course it is probable that the Air Ministry will not accept their resignation when they are required for civil flying.

As the Air Ministry has signified its intention to assist private enterprise in the development of future aerial transport, and as they also propose that all pilots engaged on this work must hold a Government certificate as to their efficiency, could not arrangements be made to allow all such officers to remain in training with the R.A.F. until such time as they are actually required for civil flying fixing a maximum limit of, say, two or three years. Whilst with the R.A.F. it would be a great benefit to these pilots if they were detailed to undergo a course of instruction at one of the Navigation Schools, or, better still, if the Air Ministry would form a special school for instruction in civilian navigation. After undergoing this course these officers' services could be utilised as practical Navigation Instructors to Service squadrons until such time as their services are required for civilian aerial transport.

Obviously, it is essential that something should be done to enable these officers to continue their flying practice until they are required, and the adoption of such a procedure as that outlined above would result in a greater efficiency of civil pilots and would eliminate the possibility of such officers being out of employment on demobilisation as would otherwise be the case.

A decision by the Air Ministry regarding this matter would be welcomed by a large number of officers who are interested in civil aerial transport of the future, and it is hoped that the point may be taken up by those in authority at an early date.

W. A. WARWICK.

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Encouragement!

A MESSAGE from Paris says that although Mr. Farman had received permission from the French authorities to fly one of his "Goliath" machines to London, the British authorities stood in the way. However, in order that the experiment might be carried out the French Government decided to buy the machine and it is now under their control. Unfortunately the weather on Sunday last prevented any trial being made.

Aeronautic Legislation for Scandinavia

AT a meeting of the Scandinavian aeronautical societies held in Copenhagen recently, it was decided that the three Scandinavian countries will appoint a joint commission in order to consider international air service regulations as they may affect Scandinavia.

An Air Map of Rhineland

ALTHOUGH hostilities have ceased the R.A.F. are putting in some highly useful work by compiling a great photographic map of all the enemy territory we now occupy. The Flying Services of the allied armies on our flanks are co-operating in the work, and the map will form a continuation of those relating to France and Belgium, which are being prepared by the rearward squadrons.

The New York Show

ON the urgent representations of the Aircraft Manufacturers Association, President Wilson has rescinded the proclamation of a year ago prohibiting the exhibition of aircraft during the war. Active work is now in progress in connection with the organisation of an aircraft exposition to be held at the Madison Square Gardens, from February 27 to March 6.

Aerial Services in Brazil

A BRITISH commercial aeroplane concern is said to be seeking a concession for the establishment of an aerial route from Pernambuco, Brazil, to near Rio de Janeiro (over 1,200 miles). It is intended to extend the system to Buenos Aires later.

THE REPORT OF THE CIVIL AERIAL TRANSPORT COMMITTEE

(*Continued from page* 125.)

[*In this issue we conclude the publication of the Appendices to the final report of the Civil Aerial Transport Committee. The Report itself was published in our issue of December* 12. *In our issue of December* 19 *the interim report was given, together with Appendix I, dealing with legislation. Appendix A, giving the International Convention drafted at Paris in* 1910, *together with the draft of a bill for the Direction of Aerial Navigation, etc., appeared in the issue of December* 26. *In the issue of January* 2 *Appendix II was published, dealing with the commercial uses of aircraft, including several appendices memoranda on various subjects. In the issue of January* 23 *were a number of other appendices dealing with questions relating to commercial flying and labour in the industry.*]

APPENDIX VII

Interim and Final Reports of Special Committee No. 5.
Interim Report.

The Committee were asked to advise upon research and the special scientific education of expert designers, engineers, and pilots, with special reference to certain details of those lines of enquiry which are dealt with *seriatim* in the present report. The two subjects of research and education form convenient main divisions as a basis for their report, and the Committee propose to take them into consideration in the order named.

I. *Research.*

1. In classifying the different headings into which the general subject of research most conveniently falls, the Special Committee have adopted the following division :—

(*a*) Invention in regard to aeronautics. (*b*) Experiments in regard to aeronautics. (*c*) Research in regard to meteorology. (*d*) Accident investigation.

2. In so far as the headings (*a*) and (*b*) are viewed in the light of any scheme for the encouragement and development of research, they are so closely connected that the Committee find it convenient to deal with them together.

The development of aeronautical science has been very rapid, both before and during the War, and, owing to the necessity in military and naval interests of keeping inventions and data connected with this science secret, the full publication of results in the interests of the aircraft industry has been impossible. During the years preceding the War the Secretary of the Advisory Committee on Aeronautics prepared abstracts of foreign scientific literature, which were published as an appendix to the yearly reports of the Committee. These reports only contained the results of such scientific work as had then been published (as distinct from work accomplished which far exceeded that made public at any rate in Great Britain), but even these were not available to the ordinary investigator in a comprehensive or convenient form. The same remark probably applies to similar reports from scientific institutions on the Continent. There now exists a vast body of information which when made available in some well-ordered form after the War will be of vital importance to the development of aeronautical science. The chief mines of such information are :—

(*a*) The Advisory Committee on Aeronautics. (*b*) The Technical Officers of the Air Board. (*c*) The National Physical Laboratory and the Royal Aircraft Factory.

3. The Committee hold a strong view that as a basis for research this information must be collected and arranged. This will involve considerable labour, which the Committee think can be divided as follows :—

(*a*) The compilation of a bibliography and of short abstracts of the principal papers ; (*b*) the publication of an aeronautical treatise embodying a full account and critical analysis of the information available ; (*c*) the publication of reliable text books, based on such well-verified conclusions as can be drawn from this information.

Of these the most important is the preparation of the treatise mentioned in (*b*), and the Committee refer with approval to a report on this question by Sir R. T. Glazebrook and Professor Petavel, which is attached as Appendix A to this report. They draw attention to the outline scheme setting out the different sections of aeronautical science which such a treatise should cover.

4. It seems clear to the Committee that the work comprised in headings (*a*) and (*b*) in the preceding paragraph should be undertaken by the same organisation, and the question arises as to the constitution, finance, and control of such an organistion. The results of the work so undertaken would benefit the Government, the industry, and the public, but the most direct benefit would be that to the Government. The sources of information are under Government control ; but the information itself is in such a scattered and disjointed form as to be only understandable by those who have in fact followed the details step by step, within the Government offices, and only with considerable difficulty even by them. Accordingly, the Committee recommend the institution of a bureau for collecting and disseminating aero-technical knowledge in the interests of civil aeronautics, which, pending the establishment of a Research Association for the industry, should be financed by a grant from the Department of Scientific and Industrial Research. The bureau might, perhaps, be attached during the War period to the National Physical Laboratory, and could be staffed by an expert investigator with assistance and the necessary clerks. An estimate has been received that a sum of, say, £2,000 per annum would be sufficient to meet the cost, both of the bureau and of producing the treatise referred to in (*b*) in the preceding paragraph. The initiation of this work is so important, and the process of collecting the existing data must necessarily be so slow that the Committee think that the bureau should be set up without delay during the War, accepting the view that it will probably be necessary to treat the information prepared as confidential, but in the hope that secret information will in due course become available for the British investigator.

5. As to the publication of reliable text books mentioned in para. 3 (*b*) above, the Committee doubt whether this will require Government intervention. The production of such text books might, no doubt, be left to private enterprise, but their initiation is of great importance and urgency, and there is danger that, in the absence of an appropriate grant from the Government, a very long time would elapse before such a venture would offer sufficient inducement to any private individual to make the effort to start it.

6. The foregoing paragraphs deal with the materials upon which a certain part of aeronautical research can be based. There remain to be considered the problems of finding what machinery or organisation shall carry on (*a*) tests and investigation of finished products—aircraft, engines, and sundries, and (*b*) further research, including physical, model and full scale. The Committee desire to emphasise the close association of these two different functions of the research organisation, because the proper carrying out of any tests of performance under (*a*) essentially involves the use of a skilled staff such as could well be drawn from a body engaged in research of the kind indicated in (*b*). The important question of the certification of the routine products of manufacture as distinct from experimental construction though closely related to the problem submitted to the Special Committee falls outside their terms of reference.

7. The Committee appreciate the fact that much useful research work is being done, and will be done, in Universities and Technical Institutes, and they note with satisfaction the recent announcement that the Research Department have made a grant to Professor Bryan, F.R.S., of the University College of North Wales to enable him for a whole session to carry on aeronautical research. At the same time, they feel that, since it is desirable to maintain in practice the close connection between research and test work, the institution, for the benefit of all constructors, of a Central Research Laboratory is desirable. Connected with such a Laboratory the Committee recommend the establishment of a Central Aircraft Test Ground and Testing Establishment. The aim of the former would be to form a centre of study of aeronautical problems, and the aim of the latter to provide reliable and impartial test results to the constructors and designers of the country, whether on their experimental or on their routine production. The Committee think that it is essential that the Laboratory and the Test Ground should be combined in one establishment.

8. At present the Society of British Aircraft Constructors are considering the formation of a Research Association in conformity with the rules laid down by the Department of Scientific and Industrial Research. The proposal to form such an association has already been approved in principle. No details of organisation, control, or finance are as yet available ; but it is assumed that it will be in receipt of funds contributed by the firms who are members of the Society of British Aircraft Constructors, many of whose individual engineers will also be represented as members of the Aeronautical Society on the Board of the Research Association.

9. It is thought desirable that the Laboratory and the Testing Establishment should be in one place, and the following scheme represents what the Committee are prepared to recommend in the light of their present information :—

(1) A Bureau for the preparation of the bibliography and treatise proposed above (paras. 3 and 4), to be established at the National Physical Laboratory under the control of, and paid for from State funds made available for, that institution. (2) A Central Research Laboratory (see above paragraph 7). (3) A Central Aircraft Test Ground and Testing Establishment (see above paragraph 7).

If (2) and (3) should be, like (1), under the control of the National Physical Laboratory, they should undoubtedly be established at some place where there is ample room for a ground of adequate size, if not on an existing aerodrome, near a centre of scientific effort, such as London. This is of the essence of the matter, and makes it impossible to recommend that the establishment should be at Teddington, where sufficient space is not available. The funds required for (2) and (3) should be provided by grants from the Department of Scientific and Industrial Research and by contributions from the industry, which, for this purpose, means the Research Association mentioned above in para. 8. Suitable fees might be charged to individuals for tests carried out on their behalf by the Testing Establishment. The results of such tests could and should be treated as confidential whenever the individuals on whose behalf they are made desire it.

10. The importance of meteorology in the development of aeronautics can hardly be over-estimated. The Committee were entrusted only with the question of research in regard to meteorology, and they understand that the question of the dissemination of meteorological information after it has been obtained, is being dealt with by Special Committee No. 2. The problems of meteorological research have been dealt with in memoranda by Major Lyons and Sir Napier Shaw, which are appended to this report (Appendices B and C). In these memoranda the Committee desire to draw attention to the following points :—

(*a*) The necessity for a closer study of atmospheric conditions at great heights. (*b*) The investigation of the phenomena of mist and fog and abnormal air currents in special localities. (*c*) The necessity for an organised scheme for improving the supply of information from the meteorologist to the flyer and *vice versa*. (*d*) The desirability of preparing meteorological information in a form most suitable for aviators from the existing material, not only for the United Kingdom, but for so much of Europe and for such air routes as may be selected.

11. In the case of meteorology, it is practically impossible to divide research proper from the dissemination of the results of that research. For this reason the Committee approve of the conclusions drawn by Sir Napier Shaw in paras. 2 and 3 of his memorandum (Appendix C), and they strongly support the other recommendations contained in the two memoranda (Appendices B and C), which may be summarised as follows :—

(*a*) The necessity for increased facilities for aeronautical research at the Meteorological Office. (*b*) The necessity for local meteorological establishments at appropriate terminal aerodromes, connected by telephone with the Meteorological Office and with each other. (*c*) The necessity for instituting meteorological research centres in connection with Universities and other centres of education. (*d*) The necessity for the issue of suitable handbooks for the purpose of instructing flyers in meteorology.

12. In connection with the proposed local meteorological establishments mentioned in (*b*) of the preceding paragraph, the Committee recommend that the practical suggestions in matters of detail put forward in a letter from Sir Napier Shaw dated August 25th, 1917 (Appendix D) should be adopted. Army Meteorological Stations now established in France, and a considerable number of Naval Meteorological Stations in the United Kingdom will serve as models for these local stations, and the experience gained in the former will be available. Recommendations (*a*) and (*d*) of the preceding paragraph should be pressed upon the attention of H.M. Government, and recommendation (*c*) should be brought to the notice of the Universities and leading Technical Institutions of the United Kingdom.

13. The foregoing recommendations will render necessary an increase in the staff of the Meteorological Office, particularly as the Committee is disposed to think that all the local meteorological establishments should be under the direct control of that office. In the case of State-owned aerodromes the matter is clearly capable of easy arrangement between the Meteorological Office and the Department controlling the aerodrome, while in

private aerodromes the advantages to the owner of the presence of a meteorological station are so obvious that it is not to be supposed that he would raise any objection. Any expense consequent upon the provision of these meteorological stations should fall upon Government funds, and the working out of the necessary details should be left in the hands of the Meteorological Office. The Committee further desire to emphasise the necessity of ensuring co-operation between the Meteorological Office and the Dominion Authorities responsible for the organisation of meteorological stations in the Dominions.

14. It will be observed that the Committee have not dealt with the problem of accident investigation mentioned in para. 1 of this report. They are proposing to consider this question with the assistance of a memorandum thereon by Mr. Harper and Captain Hucks. The Committee's views on this point and their conclusions as to the special scientific education of expert designers, engineers, and pilots, particularly in relation to navigation, will be included in a second report to the Main Committee.

Mervyn O'Gorman, Lieut.-Col. (Chairman); Leonard Bairstow; H. T. Baker, Major; A. E. Berriman; R. T. Glazebrook; H. Frank Heath; H. G. Lyons, Major; E. M. Maitland, Wing Captain; Arthur Morley; J. E. Petavel; J. C. Porte, Wing Commander; R. M. Ruck, Major-General; W. P. Schreiner; G. I. Taylor, Major; E. R. Wayland, Lieut.-Col.; H. White Smith.

D. O. MALCOLM (Secretary).

November 17th, 1917.

FINAL REPORT.

As stated in the final paragraph of their interim report, the Special Committee propose to deal in the present report with the subject of accident investigation, being the remaining heading of the branch of their enquiry relating to research, and with the second branch of their enquiry, viz., special scientific education of expert engineers, designers, and pilots.

I. RESEARCH (continued).

15. The investigation of accidents has been considered by the Committee from two points of view, namely, how far such investigation is necessary in the interests of public safety, and how far it will be of assistance in the advancement of aeronautical research, and in the improvement of design, construction, and piloting. In a general view of accident investigation the Committee have been greatly assisted by a detailed memorandum prepared for their use by Mr. Harper and Captain Hucks, which is attached to this report as Appendix E. This memorandum deals with the subject under different heads, and contains much useful information of a technical character, including a summary of the work prior to the War, of the Public Safety and Accidents Investigation Committee of the Royal Aero Club and Aeronautical Society.

16. There appears to the Committee to be a broad distinction between accidents occurring to aircraft carrying passengers for hire and those occurring to aircraft privately owned and used. In the former case investigation of an official nature seems necessary in the interests of the public and the analogy is suggested of the investigation undertaken by the Railway Department of the Board of Trade of accidents of a serious nature on railways. The Board of Trade enquiries are undertaken by officials possessing a wide expert knowledge of their subject, and it seems to the Committee that the investigation in the case of aircraft should similarly be undertaken either by or with the assistance of experts. The Committee, therefore, recommend that all accidents of a serious nature to aircraft carrying passengers for hire should be the subject of an official investigation, and that power should be conferred on the appropriate Government department, whether it be the Board of Trade or the Air Ministry, to compel such investigation and to regulate the manner in which it should be undertaken. In view of their opinion as to the necessity of expert assistance, the Committee further recommend that in carrying out their duties in this respect, the Government department should invite the co-operation of the research organisation referred to in their Interim Report.

17. In the case of accidents to aircraft privately owned and used, it appears to the Committee that investigation should not be made a matter of compulsion. The information obtained therefrom may, however, be of the greatest assistance in the advancement of aeronautical knowledge, and should be regarded as an aid to research generally. Before the War the Public Safety and Accidents Investigation Committee of the Royal Aero Club and Aeronautical Society were able, without possessing any compulsory powers, to obtain much useful information as to the causes and prevention of accidents. The Committee recommend that after the War steps should be taken to ensure the continuance of this or a similar Committee to carry on the work of investigation of accidents other than those referred to in para. 16, and that such Committee should co-operate with the research organisation in furnishing to them the data obtained in their investigations.

II. EDUCATION.

18. The modifications in the conditions of civil life introduced by new inventions have in the past followed a gradual development. Progress in design and construction has resulted from experience gained in everyday use. Rail and road transport are but two illustrations of this process. Aerial transport will probably form a unique exception to the rule. The aeronautical industry was in its infancy when the War started, and, when peace is declared, will find itself grown up with the advantage of a great body of accumulated knowledge. This knowledge will have been acquired solely from the military use of aircraft, and may not be immediately applicable in all respects to the problems of civil aeronautics. Some period of time will, no doubt, have to be devoted to the design of purely commercial machines. Nevertheless, there is every reason to expect that the industry will be in a position to meet efficiently and adequately the urgent demand for more rapid transit, and that aerial transport will pass, though not without an awkward transition stage, into the routine of civil life.

19. The requirements of military aeronautics will by no means cease with the War. The country has no doubt realised that safety requires the maintenance of two fleets, and the necessity of shouldering the financial burden involved in the maintenance of an efficient aerial navy. We may, therefore, conclude that aeronautical construction will, whether measured by the capital invested or the labour employed, eventually rank among our most important industries. The prosperity of an industry depends in the first instance on the demand for its products, and in the long run on the efficiency of the production; it is first stimulated by national requirements, later on by international competition. Where the manufacture is a matter of old-established routine and custom, its rise or fall is slow, but rapid where sound scientific knowledge and high technical skill are essential.

20. We are thus led to the conclusion that the demand for the best training in aeronautics is urgent, and that, including all classes, from the skilled artisan to the scientifically trained engineer, and from the air mechanic to the pilot working on international lines of communication, the numbers of men to be trained will be considerable. At the present moment the War has emptied the Universities and Technical Colleges, and consequently there is no supply of men whose scientific education and engineering training would otherwise have been in progress or in course of completion. The recommendations which follow should, therefore, be read as applicable to a future period when the disturbance caused by the War, particularly in educational progress, has ceased.

Engineers and Designers.

21. It is not proposed to deal here with the training of the mechanics or artisans, who, of course, form numerically the largest portion of the total; this matter has been referred to another Special Committee. Their training will doubtless entail the formation of special classes at the principal technical schools, more especially at those situated in the neighbourhood of important works or aerodromes. At these institutions classes will also be organsied suitable for engineers and draughtsmen who wish to improve their theoretical knowledge while engaged in practical work. On the other hand the engineering schools at most Universities will doubtless recognise that, just as under present circumstances the education of a mechanical engineer is incomplete without some general knowledge of electrical engineering, so, in future, all engineers should have at least a superficial knowledge of aeronautical engineering. For the civil engineer it will offer some instructive instances in the study of structural design, and some reference to aeronautical engines will necessarily form part of any mechanical engineering course.

22. The least numerous, but not the least important, class to be provided for is that which includes the men who, in due course, will direct research, design, and construction. Aeronautical engineers must, in the first instance, be fully qualified mechanical engineers, having had a sound, practical and an advanced theoretical training. They should, in addition, have had an opportunity of devoting adequate time to the scientific study of aeronautics, and be familiar with the details of aircraft design and construction. It is evident that the period of study will be longer, and the test of ability more stringent, than in many other branches of the engineering profession.

23. The Universities provide courses in mechanical engineering which extend over three years. Such courses would form a satisfactory preliminary to the more specialised training. During this period the student intending to specialise in aeronautics would spend his long vacation in aircraft works, and thus acquire some practical knowledge. The fourth year would be devoted entirely to specialised study, and would be followed by one or two years' experience in works, including a period in the drawing office and a period on an aerodrome. After such a training the student would be fitted for a position of some responsibility, and should have a reasonable prospect of rising, in due course, to the top of his profession as a consulting engineer, a managing-director, a chief engineer, chief designer, or chief draughtsman.

24. As outlined above, the specialised training of the aeronautical engineer would be a post-graduate course, and the question arises as to the nature of the institutions at which such courses should be organised. It has already been pointed out that whatever the development of the industry may be, the number of posts suitable for men of the highest standard of training is necessarily limited, and it is equally obvious that men possessing the combination of theoretical aptitude and practical ability required to profit by such a training are not numerous. Before the War the total yearly number of honours graduates in engineering, including civil, mechanical, electrical engineering, and naval architecture, etc., from all the Universities in the United Kingdom average about 200.

25. It would appear, therefore, that one or two institutions could deal with the demand which will arise for the highest specialised training in aeronautical engineering. Such an institution should certainly exist in the London district, and one in the North of England or in Scotland would probably also be required. The London school might either be :—

(*a*) Attached to the Imperial College, where the students would have the advantage of coming in contact with the members of a distinguished teaching staff, and could conveniently make use of many of the existing laboratories; or (*b*) it might be attached to some research and testing institution, established on an aerodrome, and, in connection with its educational work, be recognised by the University of London.

If the school were attached to the Imperial College, the buildings might be situated on the ground of the Central Research Laboratory suggested in paragraph 9 of our interim report. Those attending the school would then be under the Imperial College for all purposes of teaching, but would have access to the Central Research Laboratory for the purpose of studying experimental work. Such an arrangement would involve co-operation between the bodies named, the student dividing his time between the two.

26. There are, of course, men who could ill afford the considerable expense involved by so prolonged a period of training. An adequate system of scholarships, financed by the Board of Education, should be established, so that no student of exceptional ability need abandon his studies through the want of the necessary financial resources. On the other hand, many men likely to prove of great value to the industry may not possess the necessary aptitude or the inclination to carry their theoretical studies to the highest point.

27. The system of education should be sufficiently flexible to provide for the full development of any exceptional ability in whatever direction it may be. In the present case it would be desirable for the Central Institution recommended in paragraph 25 also to provide courses based on a sound general engineering knowledge. Men attending these courses would presumably be required to have studied for two years at some recognised institution, either a university or a higher technical school, and to have had some works experience.

The establishment of such an institution would involve a considerable expenditure of capital. No such institution is self-supporting, the fees forming usually but a small proportion of the total expenditure. A yearly sum of about £6,000 would be required.

Training of Flyers and Pilots.

28. It is not possible to outline a scheme for the training of civil flyers and pilots without first considering briefly the new conditions which will follow any extended adoption of aircraft for transport work.

It may be assumed that, apart from naval and military aircraft, two classes of aircraft will exist :—

(*a*) Those owned by companies which will maintain passenger or despatch services, or be chartered for special journeys.

(*b*) Those owned by private individuals, which will occupy a position between the yacht used exclusively for pleasure and exploration and the private motor car used for pleasure and business.

These will naturally be employed on various services which may be subdivided into :—

(i) Local.
(ii) National.
(iii) International.

29. Before the War there were in this country some 5,000 yachts and several hundred thousand private cars. With regard to numbers, the privately-owned aircraft may eventually be expected to reach an intermediate place. In many cases the owner will qualify as a flyer, and some of his employees will, presumably, be primarily expected to look after the upkeep of the machine, but will doubtless be required to be capable of flying it also. The owner's training will depend on the time he devotes to it, and his desire to excel in it. No definite rules can be laid down for his training; but we can assume that a considerable number of pupils of this kind will present themselves at the various training grounds.

30. Those who adopt flying as an employment (apart from a few amateurs, who might receive a nominal remuneration, and would expect to be provided with a staff of mechanics to keep the machine in order) will probably be drawn from two classes :—

(*a*) The professional flyer, who will receive a substantial remuneration, and will be the responsible supervisor of a staff who will attend to mechanical matters.

(*b*) The chaffeur-flyer, who will be expected to clean and repair the machine, and be capable of flying it when required.

These classes will, no doubt, hold a certificate awarded on the successful completion of some prescribed course of tuition in flying. The chaffeur-flyer will, in addition, be required to possess the qualifications of a skilled mechanic, and in the event of such a flyer taking charge, of passenger aircraft plying for hire, there will be special obligatory tests of qualification to ensure adequate protection for the public.

31. The three classes of commercial transport will call for men of different training :—

(*a*) For local transport, proficiency in flying and knowledge of the rules of the air and of agreed signals will be essential qualifications.

(*b*) For national transport, involving long journeys in the United Kingdom, *e.g.*, from London to Glasgow, a knowledge of map-reading and some knowledge of meteorology will be necessary as additional qualifications.

(*c*) For most international transport routes a knowledge of navigation and a more complete knowledge of meteorology will be required, in addition to the qualifications mentioned in (*a*) and (*b*).

It is indispensable in all cases that there should be a proper understanding of all the instruments employed and of the elements of the scientific reasons for their use.

It is probable that aircraft used on international lines of communication will eventually be of large size. In this case the man at the controls becomes the helmsman, and the craft is under the command of a captain or pilot. *Mutatis mutandis*, the training required for this post is that received by the navigating officer of a liner. An appreciation of the functions of wireless telegraphy will also be needed.

32. The above forecast appears to indicate that a large number of schools will be required for tuition in flying, whether or not special flying certificates are sought. Presumably most main aerodromes will have a flying school attached. The object of the tuition in such schools has in the past been to reach the standard set by the certificate* of the Royal Aero Club, and the Committee consider that there would be advantages in continuing this system.

33. In addition, at least one school of aerial navigation will be required, at which, amongst other necessary subjects, map reading, the use of the compass, astronomy, signalling, and wireless telegraphy and meteorology will be taught.

34. The standard required for the flying certificate should be reached after a few months' training in an aerodrome. It would imply the ability to fly any usual type of machine, and a number of extended cross-country flights would be required. It would not imply any special engineering training, but merely the knowledge required to verify the adjustment of the rigging, to start and control the engine satisfactorily, and to adjust and replace valves and minor fittings. The courses at the school of navigation would extend over one year, at the end of which time the students would be required to pass an examination in the subjects taught. The training in navigation could not, however, be regarded as complete until the student could give proof of continuous and satisfactory practical experience extending over a period of time.

Mervyn O'Gorman, Lieut.-Col. (Chairman) ; Leonard Bairstow ; A. E. Berriman ; R. T. Glazebrook ; H. Frank Heath ; H. G. Lyons, Maj. ; E. M. Maitland, Wing Capt. ; Arthur Morley ; J. E. Petavel ; J. C. Porte, Wing Commander ; R. M. Ruck, Maj.-Gen. ; †W. P. Schreiner ; G. I. Taylor, Maj. ; E. R. Wayland, Lieut.-Col. ; H. White Smith.

D. O. MALCOLM (Secretary).

December 29th, 1917.

APPENDIX A.

Report on the Preparation of an Aeronautical Treatise.

At the June meeting of the Committee, a Panel, consisting of Maj. Taylor Professor Petavel, Mr. Berriman, and Mr. Selby, was appointed to draw up some suggestions for a treatise on aeronautics, to give effect to Professor Petavel's proposal No. 3. The main purpose of such a treatise would be to put in a convenient form the present results of scientific enquiry into aeronautics. The material for such a treatise would be found in the Technical Reports of the Advisory Committee for Aeronautics, the publications of M. Eiffel, and the papers issued from the Aeronautical Institutes at Gottingen, Koutchino, and elsewhere. Other important sources of supply will be the Transactions of the Aeronautical Society, the various technical journals, English and foreign, and existing books.

Such a treatise would be the work of various writers ; the first step would be to find an editor, who would, no doubt, write some parts of the book himself, but whose main work would be to obtain and edit the various contributions which would go to compose the treatise.

If a scheme for issuing abstracts is developed, it might perhaps be arrangeb that the same man should act as editor for this, but that ought not to be looked upon as essential.

Some estimate of the time required and the funds necessary to pay the editor and staff must be formed. It is difficult to do this with any completeness until the editor has been provisionally select,ed and some scheme for the contents of the book has been approved. Some portion, at any rate, of the cost ought to be recovered from the sale of the book.

It would, no doubt, be desirable for the Sub-Committee to indicate the name of a possible editor, to make some suggestion as to the remuneration he should receive, and, if possible, to frame an estimate of the time required to write the book, but under present war conditions it has not proved feasible to do this. The Sub-Committee, however, have reason to hope that Mr. Bairstow would undertake the duty on the conclusion of peace, or failing this, we may look for assistance as editor from Mr. Selby.

Mr. Selby has prepared a schedule of the suggested contents of the Report, as an indication of what the Committee have in view, not with the intention of settling its future contents now ; this must be left to the editor.

R. T. GLAZEBROOK.
J. E. PETAVEL.

10th October, 1917.

Rough Outline Scheme for Report on Present State of Knowledge in Regard to Aeronautics.

1. *General Principles and Theorems in Aerodynamics (and Hydrodynamics).*—Brief account of general theory. Motion of a solid through a fluid ; comparison of air and water (air incompressible). Skin friction. Eddy motion. Theory of model experiments. Principle of dynamical similarity. Motion of fluids in pipes (heat and momentum), etc., etc.

2. *Methods of Measurements for Models.*—Velocity measurement. Resistance measurement ; wind channels and whirling arm Photographic examination of flow, etc.

3. *Resistance Determinations in Simple Cases.*—Experiments on square and rectangular plates, spheres, cylinders and wires (normal and inclined), stream-line wires and struts, stream-line bodies. Distribution of pressure.

4. *Experiments on Aerofoils.*—Inclined planes, single wings ; aspect ratio ; camber of surfaces, position of max, ordinate, form of wing tips, etc. Biplanes, etc. Pressure distribution.

5. *Experiments on Bodies and other Parts of Aeroplanes.*—Bodies (and control surfaces). Struts—effect of yaw. Stream-line wires. Wheels, etc.

6. *Experiments on Complete Models.*

7. *Airscrew Theory and Experiment.*

8. *Engines.*—Experimental investigations ; heat flow, compression ratio ; effect of altitude, starting, etc., etc.

Radiators. Design ; air-cooled and water-cooled. Methods of test.

9. *Application to Full Scale Machine.*—Aerodynamic performance, methods of calculation, R.A.F. diagram, ascending and descending flight, etc., etc. Loads taken in flight. Full scale experiments.

10. *Stability.*—Theory and determination of rotary coefficients, effect of controls, etc. Practice.

11. *Design and Strength.*—General procedure and different types of machine. Stress calculations, methods of test. Stresses in wing fabric. Propeller design. Experimental work bearing on strength, vibration o wires, tail vibration.

12. *Seaplanes.*—Float experiments and water performance. Aerodynamic performance.

13. *Airships.*—Model experiments—pressure distribution, fins, etc. Airship sheds and screening. General conditions of motion. Stability. Strength and design. Hydrogen, ballast, &c.

14. *Materials of Construction* —Fabrics, airship ; fabrics, aeroplane—with methods of test.

Dopes varnishes etc. Timber. Light alloys. Special steels.

15. *Instruments for Use on Aircraft.*

16. *Aircraft in Warfare.*—Bombs and bomb dropping. Attack of aircraft from aircraft, etc.

17. *Meteorology.*—General. Application to (i) airships, (ii) aeroplanes.

APPENDIX B.

Memorandum on Research in Regard to Meteorology.

The increase of aviation which will be brought about by the introduction of aerial transport on a commercial basis will greatly enlarge the demands made upon both practical and theoretical meteorology, in order that the dangers and obstacles due to meteorological conditions may be reduced so far as may be practicable.

These demands must be met by both special investigations into various meteorological problems, and the provision, in forms suitable to the needs of aviation, of the information which has been accumulated during more than half a century of co-operative effort.

Modern meteorology has been built up on the study of the physics of the atmosphere, and further advance will be attained by the same method. The investigation of such phenomena as the formation of mist and fog, conditions which affect visibility, turbulence in the lower strata of the atmosphere, which are already being studied, are types of the work required, and other problems will doubtless be suggested at the meetings of this Committee. The Central Institute, the Meteorological Office, and its Observatories, will naturally be largely occupied with this form of research, but it may be assumed that, as soon as the universities provide facilities for the study of advanced meteorology, such investigations will be undertaken there also.

Weather changes, forecasts, and warnings can only be adequately studied at the Central Institute, where large-scale working maps are prepared regularly, at which data are received several times daily and where a very complete collection of meteorological data from all countries is available for comparison study, so that the practicability of extending the period for which weather changes can be foretold must be undertaken there.

The study of the special features of the weather in localities where winds of exceptional violence, great turbulence of air currents or other abnormal phenomena occur, will be important, and this will necessitate a scheme of suitably planned observations taken on the spot, together with their critical discussion by competent meteorologists.

While pure research, the investigation of phenomena under well-defined conditions will always go on more or less steadily, provision must be made for the further study of the phenomena under various meteorological conditions to determine the modifications which may be caused. This extension of the work is essential in order that the results of meteorological research may be of practical utility.

Intimately connected with such investigations are the collection and discussion of the material on which they are based. Observations of pressure, wind, temperature, rainfall, fog, etc., have been accumulated for many years past, but both those of this country and those from many places abroad will require re-discussion in order to provide the special kind of information which is now required, and which differs from that which is used for climatic studies. Observations of the upper air have become very numerous and are constantly increasing ; they, too, have to be compiled and prepared for ready reference. In this field particularly a closer connection between the practical experiences of the pilot and the investigations of the scientific meteorologist is most desirable, for what is a matter of common knowledge to the one may provide confirmatory evidence for which the other has been vainly seeking.

The present supply of data from ships will need increasing where routes cross the sea, in order that the information available on land may be extended to the sea area with confidence ; and to this will now be added the observations made or obtained by aviators during their flights. To combine these satisfactorily with those representing the conditions over neighbouring areas will require the same careful organisation as was necessary for marine observations when wireless telegraphy was first introduced, for incorrect observations or data obtained by faulty instruments lead to false conclusions which may not be merely useless, but even dangerous.

The incorporation, discussion or recasting, as may be necessary, of the meteorological data of foreign countries, as it becomes available, will also be an important duty of the Central Institute.

The speed of modern aircraft moving along air routes will presumably necessitate some rearrangement in the provision of forecasts and weather warnings. While the Central Institute will receive reports from a very wide area and deduce from them the probable changes which will occur, a well-selected network of secondary stations will also be necessary. These stations will receive, besides their own observations, reports from the Central Institute and other stations, which will enable them to prepare a weather-map of their district and to follow the weather changes over it in greater detail than at the Central Institute. They would be ready to furnish short-period forecasts or warnings to aviators in the district or on the section of a route passing near it. Thus the necessary organisation will include :—(*a*) Central Institute ; (*b*) Local Warning Stations ; (*c*) numerous Observing Stations, besides certain Institutes.

The Central Institute is represented by the Meteorological Office, with its observatories, where phenomena can be investigated and the results brought into touch with the practical application of Meteorology, and the existence of six observatories dependent on the Meteorological Office in different parts of Great Britain provides large opportunities for such work. At the Meteorological Office also the accumulated observations of over 60 years from many

* The term " flying certificate " is probably more appropriate than " pilot's certificate," when flying alone has formed the object of tuition.

† I doubt whether the power to order official investigation of accidents should be limited, as is proposed, to cases where the aircraft is carrying passengers for hire, and whether higher educational facilities should be limited to one or two institutions as is proposed. I sign this Report with reservation on these points.—W. P. Schreiner.

stations at home and abroad, which have been tabulated and discussed, provide a rich store of material ready for the investigation of special subjects, and the preparation of new data could be economically met by an extension of the present arrangements.

The Forecasting service will probably have to be arranged on the basis of continuous duty, so that enquiries can be dealt with at any time, and, besides the general forecasts issued at fixed hours, the Forecast Service should telegraph sufficient meteorological data to Local Warning Stations to enable them to follow the weather conditions of their districts and to give warnings of disturbances likely to affect them.

The connection between Meteorological Research and Practical Aviation could be facilitated at Aeronautical Research Centres, where a trained meteorologist could not only contribute his own observations, but also bring the practical experience of pilots to the knowledge of meteorologists, and demonstrate the bearing of advances in meteorology on aeronautics.

H. G. LYONS.

Meteorological Office, . London,
July 27th, 1917.

APPENDIX C.

Meteorological Services in aid of Aerial Transport.

Meteorological Office, South Kensington, *August*, 11*th*, 1917.

D. O. Malcolm, Esq.,
Civil Aerial Transport Committee.

DEAR SIR,—

In reply to your letter of August 4th, I quite agree with the lines of Major Lyons' Memorandum of July 27th, 1917. I should add to the preamble some words about taking advantage of favourable meteorological conditions as well as "reducing the dangers and obstacles" of unfavourable ones, because, on the whole, the weather is beneficent, and its favourable moods are as well worth considering as its occasional ill-tempers. That, however, is merely a matter of form.

2. In substance, I gather, Major Lyons suggests an extension of the present public meteorological service to meet the special and local needs of a regular service of aerial transport. A public meteorological service is essentially an organised "enquire within" upon all questions in which the weather is concerned. It must be prepared on demand to supply an answer to any question about the weather past, present or future, in any part of the world to which, in the present state of our knowledge, an answer can be given. It must, therefore, have all its information and its knowledge ready in advance before it knows what question is going to be asked. We are quite used to that situation so far as surface weather is concerned. The underlying principles of the present scheme of the meteorological service are :—

(1) The collection and organised arrangement of trustworthy information about past weather from every part of the globe.

(2) The periodical notification by telegraph of the present weather from stations representing as wide an area as possible surrounding the United Kingdom, to form the basis of maps upon which forecasts of weather are based in accordance with the recognised teachings of meteorological science.

(3) The distribution of the information so collected either in summary or detail in reply to specific enquiries or in anticipation of enquiries in common form.

(4) The study of the information collected in conjunction with that obtained at the special observatories and stations of the Office in order to improve by investigation and research, the position of the Office in relation to replies to enquiries of every kind.

3. The new features introduced by the needs of aerial transport are, first, that the subject of possible questions is extended to include the atmosphere up to 20,000 ft., a region that, until recently, we have studied only for the light that it throws upon meteorological science ; secondly, that the scientific questions that arise are rather more recondite and require more specific answers than those which have commonly been addressed to us from outide the Office in the past ; and, thirdly, that the airman's horizontal range is wider : he needs to draw upon information from a wider area, and to have the information at his disposal in a compendious form practically at any aerodrome and at any time of the day or night. In other words, there must be provision for studying the structure and properties of the atmosphere from the special point of view of aircraft, which involves some extension of our organisation for study and research, and for obtaining the material necessary for that study ; and there must be some extension of our means of communicating general and special information to those interested in aircraft.

4. What Major Lyons obviously realises is that the provision for conveying information to aircraft pilots is not complete unless the pilot has an opportunity of discussing the situation with a meteorological expert, by which I do not mean an inspired weather-prophet who makes an oracular statement that enables the pilot to dismiss the weather from his thoughts, but simply an educated person who knows what information weather maps do, and do not, contain, and what it means ; what additional information is available and where and how it is to be found. In fact, a pilot wants access to a "map room," where he can consult a weather map just as he would consult a topographical map ; but as the weather map is changeable from day to day, and even from hour to hour, it cannot be drawn once and for all and carried in the pocket on a long journey ; it must be re-drawn periodically on the spot, and the person who drew it should be there to explain its meaning.

5. At present the only public provision for consultation of this kind is at the Meteorological Office in London. Many useful consultations with balloonists have been held there, but that is not sufficient for regular aerial transport. Adequate information of the same kind is wanted in other localities. The recognised provision at present for other places is to send a copy of the Daily Weather Report, which is then somewhat belated, and has generally to be read without the advantage of an expert to consult. The alternative to posting or delivering the Daily Weather Report is to make a reply to a definite question sent by telegraph ; but one question and one answer are insufficient, everyone wants to ask further questions in case the answer to the first is not exhaustive, as it seldom is.

6. Assuming that aerodromes will be connected by telephone with what, on the analogy of railways, may be called "termini," an obvious step would be to have local meteorological establishments at those termini, such as Edinburgh or Glasgow, Liverpool, Dublin, Queenstown, Cardiff, Plymouth, and, perhaps, other places. Each establishment should consist of a "map room" in charge of an expert, who would keep a suitable library of reference, and would discuss the meteorological situation orally or over the telephone with pilots and others. These experts should be attached to the staff of the Meteorological Office and take regular turns of duty at the Office, so that they may be kept quite up-to-date both as to information and methods. Each expert would require a junior as learner, or two if the station is to be open continuously. These are the Local Warning Stations which Major Lyons enumerates under (*b*). The men to be employed on these posts should be men with ample knowledge and practice of mathematics and physics, who have had a regular course of training at a University or Technical Institute.

7. Provision of this kind is necessary in the public interest, not only for the information of airmen, but also for all the many classes of the community who are interested in an adequate knowledge of the ways of the weather as affecting, *e.g.*, shipping and other forms of transport—agriculture and horticulture—and catering. It has already been undertaken by the Officer for the Air Services at South Farnborough and for the Armies in France and Salonika. The principal difficulty that has had to be met is the lack of men with suitable training. When the war began there were not more than 20 all told on the Office establishments. Some 50 more have been passed through the Office for the meteorological service of the Armies, and many of these will be available after the war.

8. Another difficult but equally important part of the programme is the instruction of pilots and others in the methods of modern meteorology, carried sufficiently far for them to know the kind of question to which meteorological science can give an answer, so that they may not find themselves at cross-purposes in consultation with a meteorological expert. This requires the preparation of suitable official handbooks, and some provision by way of lectures or teaching for discussing the contents with the airmen. It seems important that the handbooks should be official, because they should be guides to the use of official intelligence, and that object wants to be kept steadily in view ; but it will require some pressure on the Meteorological Office to get handbooks prepared, because when a subject is developing daily under one's own hands it is very difficult to shut off and stereotype one's knowledge in a book. In a university or technical institute there are long vacations when other work is shut down, but in an office the increase of information goes on continuously, and to the writer the work gets out of date while it is in his hands. Still, it is important that this work should be done by the Office Staff.

9. There remain what Major Lyons calls "aeronautical research centres." It would be natural that these should be organised in connection with courses of aeronautical engineering and aeronautical theory at teaching centres—universities or technical institutes. The aeronautical researchers should, somehow or other, be in close communication with the aviators, but a much-frequented aerodrome in the highway of aerial traffic is not a good place for meteorological apparatus that has to project a considerable way from the ground, or that uses steel wire, as for kites and captive balloons, so the communication is best arranged through a teaching centre which is common ground. Moreover, the direction of experimental researches in the physics and dynamics of the atmosphere requires not only high professional qualifications, but also the assistance of a body of students with a good deal of available time.

10. I have set these things out at length in order to lead up to the vital question of your letter ; by what means the Civil Aerial Transport Committee could best assist in seeing that Major Lyons' suggestions should be carried out. The best means seem to me to be, first, to ask the Meteorological Committee, which has the requisite experience, to set up by way of experiment at one of the terminals mentioned a local meteorological establishment of this kind which I have indicated herein as necessary for the purpose which the Committee has in view ; and, secondly, to ask the Imperial College of Science and Technology and/or the Universities or Technical Institutes of Edinburgh, Glasgow, Dublin, Liverpool, Cardiff, Southampton and Plymouth, to set up a teaching centre for Aeronautical Engineering, Aeronautical Theory and the structure of the atmosphere ; or perhaps a circular prepared by the Committee asking universities and technical institutes to make a point of giving students the opportunity of learning those subjects which would lead to the provision which is required.

(Signed) NAPIER SHAW.

APPENDIX D.

Meteorological Establishments.

(This is not printed).

APPENDIX E.

Memorandum by Captain B. C. Hucks, R.A.F., and the Assistant Secretary (Technical), as to Accidents and Accident Investigation, with an Annex Summarising the Work, Prior to the War, of the Public Safety and Accidents Investigation Committee of the Royal Aero Club and Aeronautical Society.

It is proposed to deal with the subject under the following heads :—

I. An outline of the most common forms of accident at the present time.

II. The necessity for an investigation of accidents, even some of those not having serious results, with a view to the determination of their causes.

III. Methods of obtaining reliable information.

IV The necessity for an expert examination and classification of data obtained.

V The use to which the results of examination can be put.

I.

CAUSES OF ACCIDENTS.

Aeroplane accidents are, as a rule, due to one or other of the following causes, or sometimes to a combination of such causes :—

A.—Engine stoppage, &c

B.—Errors in Piloting. (1) Want of experience and hurried teaching (2) Real errors of judgment. (3) Rashness.

C.—Faulty construction. (1) Design. (2) Construction. (3) Materials.

D.—Dangerous manœuvres.

E.—Meteorological conditions.

F.—Fires.

G.—Illness of a pilot while in flight.

Before examining very briefly some of the accidents due to one or other of these causes, or a combination of any of them, it should be noted that with pilots who are fully experienced and know their engines, grounds, winds and weather signs, accidents under the peace conditions of flying should become rare.

A. Engine Stoppage, &c.—The stoppage of an engine in the air should not, under favourable circumstances, imply any serious risk of accident. His mechanical power gone, the flyer must necessarily descend. He can and must maintain the forward speed of his machine and the support of its planes by gliding downward in a gradually descending path ; but if he is over thickly-wooded, broken, or mountainous country, it may be difficult for him to find a suitable landing point, and he may, should he make his contact with bad ground, break some portion of his alighting gear, or perhaps damage his machine more seriously. But if he is dexterous he may, and usually does, save himself and his passengers from serious injury.

To many flyers, the sudden stoppage of their engine is disconcerting, leading them to errors of judgment they would not be guilty of under normal conditions. So it may happen that at a moment when exceptional judgment is demanded of him, a flyer is not in a condition to act correctly and with unswerving precision.

When his engine has failed a flyer's first thought, naturally, is to make a descent at some point where the ground is suitable, and where he will avoid damaging his machine, or injuring himself or his passengers. If he is near an aerodrome he will endeavour to reach this aerodrome. It has in the past happened not infrequently that an engine has failed—say through some disorganisation in the petrol pressure feed as a result of "taxying" a machine prior to a flight—not long after a machine has left the ground and before it has gained altitude. The instinct of the flyer under such conditions is to endeavour to turn his machine in the air and glide back to the aerodrome rather than make a landing in any field or open space which may lie within reach. But while in the act of turning—remembering that he has been more or less disconcerted by the sudden failure of his motor, and remembering also that owing to the rapid growth of the art of flying thoroughly experienced pilots are few—he may make the mistake of gliding at so flat an angle while on the turn that the air pressure under the inner wing of his machine falls so

low that it is insufficient for the support of that side of the machine; whereupon the aeroplane begins a side-slip which may turn into a spinning nose-dive—and this means that, for the moment at any rate, the craft has passed beyond the flyer's control. If, however, he is at a sufficient altitude when this happens, he may be able to extricate the aeroplane from its spinning dive; but should he be near the ground when his machine side-slips he will probably be unable to regain control before it crashes.*

It would be safer in some cases after an engine has failed, and particularly when failure takes place with the aeroplane at a low altitude, if flyers glided on straight ahead and did not endeavour to turn. This might, it is true, involve a descent on unsuitable ground, with some slight damage, perhaps, to the undercarriage, but this would be far better than losing control altogether. A fact to be remembered is that if an aeroplane loses flying speed while moving straight ahead it not only loses height less rapidly, but there is far less risk of a sideslip, as all stable machines tend, when the flying speed is reduced below a certain point, to take up automatically a safe gliding angle.

Probably the origin of the majority of accidents at the present time is stoppage of the engine, after which a flyer is frequently guilty of some error of judgment, or of piloting, or of both; and such errors are due in most cases to the anxiety of the flyer to reach some specific landing ground—an anxiety which will be all the more acute should engine failure have occurred when the machine is low.

This points to the fact that when airways are established, with landing grounds fairly close together along each route, the main cause of accidents will have been removed. Under such improved conditions, should an engine fail while an aeroplane is in flight, an aviator will not find it necessary to turn and manœuvre in the air, during a glide without motive power, in order to reach some landing ground that is not readily accessible. Subject to his being at a sufficient altitude, he will be able to glide to whichever alighting place on the chain of grounds may lie before him, and make a landing under favourable conditions on a sufficiently smooth ground.

Even with such landing places available, an engine may fail so soon after a pilot has left the ground that he is unable to reach the next alighting point, though this may be only a few miles distant. Under such conditions, assuming he has insufficient altitude at which to make a safe turn, he should glide down in the open country and pick the best landing he can. It is worth while, therefore, to bear this contingency in mind, and to see that the land is fairly open in the immediate vicinity of aerodromes.

Improved reliability of engines, and the rapid growth of skill, experience, and a sense of responsibility in ground men and mechanics, should render improbable cases of engine failure occurring almost directly after an aeroplane has left the ground; while the careful training of flyers should prevent them from falling into the error of starting away on a flight with a motor that is not running well.

B. Errors in Piloting.—Errors in piloting, so far as one can isolate them as a cause of accident, are not likely to involve a flyer in much danger so long as he is at a sufficient altitude. Peace-flying will also remove the necessity from all civil flyers of making those extreme manœuvres which are called for in war in darting from or at an enemy, or spinning down to get out of his reach, so that all errors connected with practising these evolutions will be absent.

The comparative leisure of peace flying should tend also to prevent accidents due to hurried teaching, or to errors of judgment on the part of instructors in ordering pupils to make flights or carry out manœuvres for which their degree of proficiency has not prepared them. Rashness on the part of young flyers, and the taking of unnecessary risks, should also be discouraged more effectually when a longer period can be allowed for tuition, and when there are not the exigencies of war to justify such risks.

Errors in piloting, when an aviator is making his contact with the ground after a flight, account for a large number of accidents, though these, generally speaking, are not attended by serious consequences. A broken undercarriage is, as a rule, the worst that happens, and though experience shows that an aeroplane may overturn occasionally and be damaged badly, its occupants generally escape. Landing with the wind instead of against it will often lead to a machine being damaged by collision through a pilot failing to bring it to a standstill within the length of run he normally expects.

Another error of piloting when in the act of descending is to alight side to wind. In this case, if the aeroplane has a sideway as well as a forward motion at the moment of contact with the ground the running wheels may buckle, and the breakage of the entire chassis, and perhaps the overturning of the machine, may result.

Such accidents in landing are not always to be laid to the door of the flyer. It may happen, through the absence of any wind-vane or smoke, which gives him a reliable indication, that he is unable to judge accurately the direction of the ground wind. When chains of aerodromes are in existence it will be easy and inexpensive to place on each, in a position where it is seen easily by a pilot while descending, some standard type of wind-direction indicator.

C. Faulty Construction.—Accidents due to faulty construction are becoming far less frequent owing to the increasing knowledge and skill of designers and constructors, the adoption of ample factors of strength, and the care which is exercised in the choice and inspection of materials employed. At present, however, greatly though design and construction have improved, it is possible for a machine in the course of the violent manœuvres dictated by war service, to be subjected to such abnormal strains that some part of it collapses and robs the pilot of control.

Another risk of structural breakage which must be reckoned with is that of a rough landing having done some damage to a machine—say to the rear of the *fuselage*. This, if it escapes detection at the time, may lead afterwards when a machine is subjected to strain, to a collapse in flight.

Constructional risks may be encountered, even in future by flyers who are called upon to handle machines of an experimental type, the behaviour of which, when actually in flight, is being determined by practical tests. These risks affect only indirectly the general public or potential passengers, who would not be introduced till long after such risks had been studied and eliminated.

D. Dangerous Manœuvres.—There should be a distinction, of course, between dangerous manœuvres which are unnecessary and those which are called for in learning, and in afterwards performing the abrupt and often violent evolutions which must be made in aerial fighting. The risks attached to the latter are inevitable while we are at war; but in commercial or pleasure flying, when only safe and reasonable piloting will be required, accidents under this heading should become extremely rare. In the Air Force naturally, even under peace conditions, dangerous manœuvres must be carried out on occasion; but there will be no justification for them in civil flying.

E. Meteorological Conditions.—Certain accidents have, it seems probable, been due to abnormal atmospheric conditions, or at least to the discomfiture of the pilot by such conditions; and data in this regard—though a certain amount of information is already available—need to be far more extensive. We refer to this question, briefly, under a later heading.

F. Fires.—This cause of accident, occurring when a machine is in flight, or when it has crashed after a bad landing, is now receiving the closest attention, and, under the less arduous conditions of peace flying, and with the experience and data already obtained, it should become possible very greatly to minimise this danger.

G. Illness of a Pilot.—In the Annex to the Appendix, a case is mentioned of an accident which was assumed to be due to the indisposition of the flyer and there have been other obscure cases which have been attributed to the same cause. In war flying, under the strain of ascending rapidly to high altitudes, in diving steeply, or in spiralling or other violent movements, cases are to be expected of giddiness, or of temporary loss of consciousness. In peace flying there should, ordinarily, be none of these extreme physical strains; and medical examinations, carried out periodically, should obviate the risk of a commercial pilot, while in charge, say, of a passenger craft, losing control of his machine through any sudden attack of illness.

II.—The Need for Investigating Accidents.

Before the war the Royal Aero Club and the Aeronautical Society, through their Accidents' Investigation Committee, whose findings in 26 enquiries we summarise as an Annex, were in the process of obtaining valuable data; while recently a committee has been appointed by the Air Board, under the presidency of Col. O'Gorman, to examine when called upon by the Services the causes of accidents which befall naval and military pilots and machines.

Hitherto, however, and at the present time, an accident has as a rule to be very serious, and generally fatal, before it is investigated; and while we are at war it is unreasonable to expect that each minor mishap shall be investigated. But when peace comes, and we enter on the era of civil aerial transport, it will be found, no doubt, that firms will investigate every accident which happens to their craft, even though this should be no more serious than the compulsory descent of an aeroplane, made without hurt to anyone on an aerodrome, through, let us say, some slight engine defect. Enterprising firms may be expected, in fact, to study the details of everything that happens which should not happen; of every mechanical breakdown, no matter how insignificant, which serves to delay or interrupt a flight; of every kind of atmospheric condition, abnormal or otherwise, which affects the travel of a machine from point to point, or produces conditions which a flyer has not experienced before.

The fatal accident is often the worst to approach from the point of view of investigation. Both the occupants of a machine, if there is a passenger as well as pilot, may be killed, while the machine itself, as the result of its crash, presents in the majority of cases such a hopeless mass of wreckage that nothing definite can be learned from it. But where we should learn valuable lessons under peace conditions, is from those small accidents which, if they are not investigated and their causes discovered and eliminated, may lead eventually to serious accidents and loss of life.

In minor mishaps the conditions are often favourable for investigation. Apart from any testimony which may be obtained from expert eyewitnesses, there are accessible the statements of those actually in the aeroplane; while there is also the machine itself, which, though it may be somewhat damaged, is rarely damaged badly enough to prevent a critical examination.

III.—Methods of Obtaining Reliable Information.

The testimony of lay witnesses to an accident who possess no technical knowledge is generally unreliable. A man may say he heard an explosion in the air, and then, shortly afterwards, saw a machine fall. This gives the impression that the accident was due primarily to engine failure. What may have happened in fact, is that the pilot merely switched off in the ordinary way and that his engine gave the not unusual exhaust pop, or backfired harmlessly, making the noise the lay witness heard. In reality the pilot, while gliding, may have lost control of his machine as the result of some error of judgment absolutely unconnected with the switching off of his engine. If too much reliance is placed on non-technical evidence, the trend of an enquiry may be misdirected; but at the same time it should often be possible, by a series of questions carefully framed, to gain useful information from a non-technical witness.

Before the war the Royal Aero Club, jointly with the Aeronautical Society, in their scheme of accident investigation, appointed technical representatives on the principal aerodromes whose duty was, when a fatality occurred, to collect all details possible, to examine the machine before it was moved, and to prepare a report which could be considered—if necessary with other evidence—by the Accidents' Committee. Here was the nucleus of an organisation, although the 15 representatives which were all that had been appointed, prior to the war, will need to be increased in numbers after the war. The representatives on the flying grounds, as appointed before the war, were not accident investigators pure and simple; their main and permanent occupation lay generally in some executive or other work in connection with an aerodrome. Accident investigation was a side issue with them, which they took up voluntarily. It might happen, therefore, under such conditions of appointment, that they were not present on an aerodrome when an accident took place. It was with such a contingency in mind that more than one accident representative was appointed on the principal aerodromes. This arrangement proved adequate in pre-war times, when only very serious accidents were investigated, but after the war it is submitted that the permanent appointment of suitable and salaried persons will be necessary. Their duty should be to investigate accidents which happen in their respective jurisdictions, and to report to some central authority, such as the Research Association. These investigators could be stationed at chosen aerodromes, and it seems probable that the widening of the field of investigation before referred to, and an increasing volume of aerial traffic would have the effect of keeping them occupied.

It is suggested that the investigators at main aerodromes should have a certain number of the subsidiary grounds in their neighbourhood placed within their jurisdiction. At these smaller grounds the expert investigator from the main aerodrome could, from among the staff available, appoint someone to represent him in the case of an accident, and to make any preliminary investigation that might be necessary before he (the expert investigator) arrived. In this way, with permanent investigators on the principal aerodromes, and with these men appointing representatives on intermediate grounds, a system of investigation might be built up.

It will be necessary to obtain the co-operation of aviators and to represent to them the value of accident investigation. This co-operation should take the form of reports by flyers not only as to mishaps, but also as to other unusual experiences due to meteorological or other causes.

IV.—The Necessity for an Expert Examination and Classification of the Data Obtained.

In the pre-war system the Accidents' Committee of the Royal Aero Club and the Aeronautical Society, after considering a fatality and agreeing as to

* *Note by Major G. I. Taylor.*

"Many accidents occur when an engine stops shortly after a machine has left the ground, and before it has attained a height of more than a few hundred feet. Under these circumstances, if the readings of the instruments are used intelligently, it is frequently possible to turn back into the aerodrome; but what often happens is that the pilot, instead of looking at the instruments looks only at the ground. Under these circumstances, after he has turned across the wind, the ground may appear to him—if the turn has been correctly banked—to be moving sideways under him, and in the direction it would appear to move if he were doing a very much over-banked turn at a greater height above the ground. The pilot's instinct is therefore to hold the lower wing up, and to make an under-banked turn. The number of accidents due to faulty piloting, on the part of inexperienced pilots during a turn near the ground, might be greatly reduced by better education, and also by a greater confidence in the instruments, which are now extremely reliable."

its view of what had occurred, issued a report. In this report, as occasion demanded, the Committee drew the attention of designers, constructors, flyers, and others to any feature of the report which seemed of importance for the purpose of preventing the recurrence of an accident from any cause established by the report.

After the war, however, when small mishaps as well as large become matters for investigation, there should be a volume of material with which to deal which should be sufficiently large to justify the establishment of a bureau, with a permanent office and staff, for the purpose of dealing with accident reports. The officials of this bureau could classify reports at first roughly, and then in greater detail, and accumulate by degrees prepared data which should, when examined finally and reported on, throw a valuable light on the question of accident prevention.

As to the institution of such a bureau, it would seem that much may be expected from the proposed formation by the aeronautical industry of Research Association, which it is hoped will be aided by financial grants from the Department of Scientific and Industrial Research, to amplify sums obtained from the industry. To the research work of this Association might, it is submitted, be added the work of a permanent bureau for the examination and classification of the reports which would be obtained from accident investigators. The bureau would have to be in free and constant touch with the industry it served (not forgetting, of course, that it would also be serving the public), and the industry as a whole would be benefited very greatly and the safety of flying increased, if there were proper access, for well-recognised persons and firms, to information in regard to accidents.

In the investigation of small accidents and mishaps, which would probably form the bulk of the work of the bureau, each case would, no doubt, be classified under some special heading, without an individual report being issued concerning it, and when there was a sufficient number of cases from which to draw definite conclusions, the director of the bureau would issue a memorandum. This would be made accessible to those engaged in the industry, and probably also to the technical and general Press.

V.—The Use to which the Results of Expert Examination can be put.

It is necessary to consider what use may be made of accident reports after they have been examined and classified, and are presented in the form of summarised statistics.

In the case of engines, it is hoped that it may be possible to discover, from an examination and classification of accidents, just what parts of any particular engine or engines are proved to be most likely to give trouble under certain given circumstances.

With designers and constructors, also, it should be possible—after a sufficient amount of accident data had been classified—to point out to them, so far as some particular machine was concerned, that a weakness lay here or there, or that the testimony of pilots was that certain small improvements were necessary to facilitate control.

It will be desirable, during the immediate post-war development of commercial flying, to secure close co-operation between the makers of aircraft and of engines and the uses of such apparatus.

Apart from accidents due, say, to engine stoppage, there will be others no doubt caused by errors of judgment on the part of aviators. In such cases, when sufficient data have been obtained from which to draw conclusions the accidents bureau would probably report to that branch of the Research Association which is considering the training of flyers and suggest improvements or modifications in tuition. It is assumed that after the war adequate tests will be enforced before a flyer is given a certificate of proficiency, and particularly that he should have had sufficient experience to enable him to cope successfully with any predicament which is likely to arise in cross-country flying, as distinct from aerodrome flying.

One respect in which the Accidents' Bureau can help in the general work of research will be in placing before the meteorological department of the Research Association all data it may be able to obtain as to the part played in any particular accident by the atmospheric conditions prevailing at the time.

Looking into the future, one sees that four factors, in addition to a scheme of accident investigation, are of importance. These are :—

1. An increase in the number of alighting grounds.
2. The elimination of engine failure.
3. The careful training of flyers.
4. The forecasting of the weather for as long a period as possible ahead and some system of distributing these forecasts rapidly to aerodromes throughout the country; also warnings of approaching weather changes of any importance.

With all these, the investigation of accidents is either directly or indirectly connected.

ANNEX.

Summary of the Work, Prior to the War, of the Public Safety and Accidents Investigation Committee of the Royal Aero Club and Aeronautical Society.

In 1912 the Royal Aero Club, jointly with the Aeronautical Society, appointed a Special Committee known as the Public Safety and Accidents Investigation Committee, to obtain reports as to aeroplane accidents, and to endeavour to discover the causes of such accidents, and to express an opinion, whenever possible, as to how they might be avoided in future. Official representatives were appointed on the principal aerodromes, whose duty it was, should an accident occur, to gain all information possible concerning it, to examine the wrecked machine, and to bring before the Committee all the information which could be secured.

Between 1912 and 1914—when the outbreak of war interrupted the work of the Committee—26 fatalities had been investigated.

The main causes of accidents before the war, as shown by an examination of the Committee's reports, were :—

1. Errors of judgment on the part of a flyer.
2. The structural breakage of some part of an aeroplane while in flight.

Nine of the 26 fatalities were due to errors of judgment.

In two cases accidents were shown to be due to a pilot attempting a flight in a machine which was out of adjustment, with the result that it side-slipped while turning.

In two others, pilots dived their machines so suddenly and steeply that they were jerked forward on to their controls, accentuating the descent to such a degree that they fell from their machines while in the air.

In two more cases, the accident was caused by a machine nose-diving while gliding, through the pilot allowing it to lose flying speed.

The remaining three cases may be summarised as follows :—

(i) A pilot was making a series of spectacular evolutions, low down over an aerodrome, when his machine side-slipped.

(ii) A pilot over-banked while turning at a low altitude, and this was followed by a nose-dive.

(iii) A pilot dived steeply, then flattened out too suddenly, fracturing a wing.

Of accidents due primarily to engine failure, or engine trouble, the Committee investigated three—though it should be noted that, in each case, and subsequent to the trouble with his engine, the flyer was guilty of some error of judgment. These cases are summarised herewith :—

(i) A pilot's engine was observed to stop when he was at an altitude of about 200 ft. Shortly afterwards the machine nose-dived. In the Committee's opinion, the accident was due to the aviator failing to appreciate the danger of keeping his craft in a horizontal position after the engine had stopped, thereby losing flying speed.

(ii) A pilot, finding his engine running badly after leaving an aerodrome, turned in the air in order to fly back to his starting point; but in making the turn he lost speed and altitude to a dangerous extent, and while passing low near a belt of trees, which may have set up disturbed air in the neighbourhood of his machine, the craft was seen to dive.

(iii) A pilot attempted a flight with an engine that was not working properly, with the result that the machine gradually lost altitude until it fell into a river.

Eight of the 26 accidents investigated were shown to be due to the breakage of some part of a machine. These may be summarised as follows :—

(i) A quick-release device of a wing-cable opened and the cable came adrift, flapping up and piercing the fabric of a wing, which then burst and allowed the machine to fall.

(ii) An aircraft collapsed in a flight through the breakage of the wires supporting a wing, following upon some derangement of the cabane, this derangement being due either to a portion of the revolving engine fouling the engine cowl, or by a partial failure or breakage of the propeller, which threw the rotating system out of balance, and set up stresses which caused the engine to shift.

(iii) The wings of an aircraft collapsed while the machine was flying in an extremely high wind.

(iv) An elevating plane broke and allowed a machine to dive so steeply that the main planes collapsed.

(v) A wing broke as the result of a faulty repair to a main-spar.

(vi) A wing failed, owing to want of sufficient strength to withstand the stresses produced either by a violent wind or sudden warping.

(vii) An aircraft collapsed while in flight owing to inherent structural weakness.

(viii) A rudder became detached from a machine in flight owing (in the opinion of the Committee) to its being insufficiently strong to resist a sudden and abnormal strain, and owing also to the fact that it had probably been strained in a previous flight.

In connection with accidents due to structural weakness, the Committee made two recommendations. One was that, as aircraft are built of perishable materials, all machines which have been in existence for some time should undergo a critical examination, both as regards framework and fabric.

The second recommendation was that all repairs to a machine must be carried out under expert and responsible supervision. As to the remaining six accidents, making up the total of 26, their causes are summarised below :—

(i) The pilot of an experimental machine lost control in a gusty wind.

(ii) A pilot ascended while in an unfit state of health, and apparently lost consciousness while his machine was gliding.

(iii) A pilot lost control through his foot slipping on the rudder-bar.

(iv) A pilot who was giving a public demonstration on an aerodrome of insufficient size turned sharply to avoid endangering spectators, with the result that his machine side-slipped from a low altitude.

(v) A pupil, flying with an instructor in a dual-control machine, appeared to resist for some unknown reason the ruddering action of the latter, with the result that the machine became uncontrollable.

(vi) A pilot who was landing, and whose view was obstructed to some extent by his radiator, ran into some people who had encroached on the flying ground, with the result that one person was killed and several injured.

The Committee found it necessary, in its endeavour to determine the causes of accidents, to request local authorities, in cases where aircraft fell in open country, to prevent the wreckage of the machine being moved until it had been examined by experts, and this will assuredly have to be carried out after the war.

Final Note.

Looking at pre-war accidents in the light of conditions such as will exist, probably, when peace comes, one very appreciable element of risk, that of structural collapse, should be eliminated almost entirely.

This being so, we find that what we shall have left, as a main risk of accident, will be engine failure, followed perhaps by an error of judgment on the part of the flyer. To lessen this risk we must, of course, perfect our aero-engines, and eliminate by degrees those small causes of stoppage, or of trouble, which (insignificant in themselves) may lead none the less to a serious accident.

It should be noted again that, when an aviator who encounters engine trouble has a chain of alighting grounds along his flying route, he will be far less likely to find himself in a critical position; also that, when we have the comparative leisure of peace in which to train flyers more carefully, and also more scientifically, they should be less likely to be guilty of errors of judgment.

B. C. HUCKS, Capt., R.F.C.
HARRY HARPER.

December, 1917.

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"Milestones"

IN our "Milestones" series published in last week's issue of "FLIGHT" certain particulars relating to the machines built by the British and Colonial Aeroplane Co., Ltd., of Filton, did not reach us in time to be included in the tables. We have now received these particulars, and in order to enable those who wish to do so to complete the table of performances given on page 104, the data are published below.

It might be added that the year in which the first machine of each type was built is as follows :—Scout D, 1915; monoplane and Bristol Fighter F2B, 1916; All-Metal, 1917, and Scout F and Triplane Bomber, 1918.

Type of machine.	Range in miles (at full speed).	Stalling Speed (m.p.h.).	Ceiling (ft.).
Scout D.	330	45	17,000
Scout F	270	50	25,000
Monoplane	230	52	24,000
Fighter F2B ..	270	50	22,000
All Metal	420	48	16,000
Triplane	700	57	15,000

THE ROYAL AIR FORCE

London Gazette, January 21.

The following temporary appointments are made at the Air Ministry :—

Deputy Med. Administrator.—M. H. G. Fell, C.M.G. (Bt.-Col., R.A.M.C.), and is granted a temp. commn. as Col. ; Nov. 26, 1918.

Staff Officer, 2nd Class.—(Q.) Capt. (actg. Maj.) J. W. Burt, and to retain his actg. rank whilst so employed ; Jan. 1.

The following temporary appointments are made :—

Area Commander.—Col. (actg. Brig.-Genl.) C. L. Lambe, C.M.G., D.S.O., and to be actg. Maj.-Genl. whilst so employed ; Dec. 23, 1918, but not to carry pay and allowances prior to Jan. 4.

Brigadier-General (Admin.).—Lieut.-Col. (actg. Col.) F. C. H. MacLean, and to be actg. Brig.-Genl. whilst so employed, vice Lieut.-Col. (actg. Brig.-Genl.) N. D. K. MacEwen, D.S.O. ; Dec. 7, 1918.

Staff Officers, 3rd Class.—And to be actg. Capts. while so employed., if not already holding that rank :—(P.) Lieut. (actg. Capt.) E. Burney, M.C., Sec. Lieut. (actg. Lieut.) J. M. McEntegart, Lieut. J. E. D. Samuel ; Jan. 1.

Staff Officer, 4th Class (1st Grade).—(Air)—Capt. H. E Parker, vice Sec. Lieut. (actg. Capt.) A. K. Spens, who relinquishes the actg. rank of Capt. ; Dec. 6, 1918.

Staff Officer, 4th Class (2nd Grade).—Lieut. J. A. Gorges ; Sept. 11, 1918.

A.D.C.—(Graded for purposes of pay as Staff Lieut.) :—Capt. F. D. Lord Doune, M.C. ; Dec. 29, 1918.

Flying Branch.

Capt. (actg. Maj.) P. H. Hepburn to be Capt. (K.B.), and relinquishes the actg. rank of Maj. ; Jan. 11.

Lieut. B. Farmer to be Lieut. (O.), from (Ad.) ; Dec. 7, 1918.

Lieuts. to be Lieuts. (A.), from (O.) :—C. J. L. Harrison ; Nov. 28, 1918. G. S. Oddie ; Nov. 30, 1918.

Sec. Lieut. C. V. Lacey to be Sec. Lieut. (A.) from (T.) ; April 1, 1918.

Sec. Lieut. W. R. Wolsey to be Sec. Lieut. (A'ship), from (Ad.) ; Oct. 14, 1918.

Sec. Lieut. H. Murray to be Sec. Lieut. (O.), from (A.) ; Nov. 20, 1918.

Sec. Lieut. W. Dixon (late Gen. List, R.F.C., on prob.) is confirmed in his rank as Sec. Lieut. (K.B.) ; Aug. 8, 1918.

Sec. Lieut. W. T. Davies (late Gen. List, R.F.C., on prob.) is confirmed in his rank as Sec. Lieut. (O.) ; May 18, 1918.

E. M. Matthew (Sec. Lieut., R.G.A.) is granted a temp. commn. as Sec. Lieut. (A.) ; July 16, 1918 (substituted for notification in *Gazette* Jan. 10.)

Sec. Lieut. (Hon. Lieut.) W. C. Broadwood to be Lieut. ; May 9, 1918.

Sec. Lieut. A. J. Stevens is dismissed the service by sentence of a Gen. Court-martial ; Dec. 22, 1918.

Capt. (actg. Maj.) Hon. O. M. Guest (Capt., Yeo., T.F.) relinquishes his commn. on being elected M.P. ; Dec. 28, 1918.

The following relinquish their commns. on ceasing to be employed :—Sec. Lieut. M. Brophy (Sec. Lieut., N. Lanc. R.) ; Oct. 17, 1918. Lieut. (actg. Capt.) F. A. Nicholson (Lieut. (actg. Capt.), New Bruns. R.) ; Nov. 27, 1918. Lieut. R. M. McDonald (Lieut., Monitoba R.) ; Dec. 4, 1918. Sec. Lieut. (Hon. Lieut.) M. D. Orr, M.M. (Lieut., Nova. Sco. R.) ; Dec. 6, 1918. Lieut. B. W. Fryer (Lieut., Can. F.A.) ; Dec. 7, 1918. Lieut. J. C. Colling (Lieut., Sask. R.), Lieut. (actg. Capt.) J. E. Pugh, M.C. (Lieut., Alberta R.), Lieut. S. M. Duncan (Lieut., Can. Res. Cav. R.), Sec. Lieut. (Hon. Lieut.) D. Gardner, M.C. (Lieut., D. Gds.), Sec. Lieut. R. Lean (Sec. Lieut., High. L.I.) ; Dec. 9, 1918. Lieut. E. Cate (Lieut., Can. F.A.), Lieut. G. H. Foy (Lieut., Fort Garry Horse), Lieut. J. D. O'Neill (Lieut., Manitoba R.) ; Dec. 10, 1918. Lieut. (Hon. Capt.) J. M. Taylor (Capt., Alberta R.) ; Dec. 11, 1918. Lieut. R. McInerney (Lieut., N. Bruns. R.), Sec. Lieut. T. Stewart (Lieut., E. Ont. R.) ; Dec. 16, 1918. Sec. Lieut. (Hon. Lieut.) T. J. Meredith (Lieut., Brit. Col. R.) ; Dec. 17, 1918. Sec. Lieut. (Hon. Lieut.) F. H. Ryder (Lieut., N. Bruns. R.), Lieut. J. L. Standish (Lieut., Alberta R.) ; Dec. 18, 1918. Lieut. (actg. Capt.), J. S. McDonald (Lieut., Cent. Ont. R.) ; Dec. 20, 1918. Lieut. G. N. Dennis (Lieut., E. Yorks. R.) ; Dec. 21, 1918. Sec. Lieut. (Hon. Lieut.) H. C. Heintzman (Lieut., Can. F.A.) ; Dec. 31, 1918. Lieut. (actg. Capt.) H. J. Burden, D.S.O., D.F.C. (Lieut., Can. For. Corps) ; Jan. 1. Lieut. L. C. Gilmour (Lieut., Sask. R.) ; Jan. 2. Lieut. J. S. Godard (Lieut., Can. Engrs.) ; Lieut. E. E. Heath (Lieut., Cent. Ont. R.) ; Jan. 4th. Capt. L. R. Andrews (Lieut. (actg. Capt.) B. Col. R.) ; Jan. 8.

Lieut. A. C. Woodman is cashiered by sentence of General Court-martial ; Jan. 1.

The following are transfd. to unemployed list :—Sec. Lieut. (Hon. Capt.) G. S. Paterson ; Jan. 4. Lieut. A. Alexander, Sec. Lieut. R. Whitfield ; Jan. 5. Sec. Lieut. J. A. Lewis, Lieut. (actg. Capt.) F. C. Muncey, Lieut. E. S. Wood (Sher. For., T.F.) ; Jan. 7th. Sec. Lieut. G. M. Anderson, Lieut. J. B. Barclay, Sec. Lieut. J. P. Findlay, Sec. Lieut. W. M. Imlay, Lieut. (actg. Capt.) B. G. King, Lieut. J. E. Tratman, A.F.C. ; Jan. 8. Sec. Lieut. F. A. Best, Sec. Lieut. F. E. W. Davies, Lieut. E. C. Harris (R.E., T.F.), Capt. G. L. Hartgill, Capt. J. E. Hillbert, M.C., D.F.C. (late S. Lancs. R.), Capt. J. Kerr, Capt. H. Kirton, Sec. Lieut. O. W. Mitchell, Lieut. (actg. Capt.) W. G. Pegg, Sec. Lieut. G. F. Underhay ; Jan. 9. Sec. Lieut. E. F. Green, Capt. W. Hosking (Capt., Dev. R.), Capt. N. M. MacGregor, D.S.C., Lieut. W. K. McMillan, Lieut. (actg. Capt.) E. A. Mearns, Lieut. S. E. M. Simpson, Lieut. L. O. Stocken (Midd'x R.), Sec. Lieut. W. J. Stratford, Sec. Lieut. E. A. Winter, R.F.A., T.F. ; Jan. 10. Lieut. K. F. Alford, Lieut. F. Forster, Lieut. C. B. J. Gledhill, Sec. Lieut. H. F. Jones, Lieut. F. P. Magoun, M.C., Sec. Lieut. B. N. Radford, Sec. Lieut. H. C. Ratcliffe, Lieut. H. M. Robertson, Lieut. W. A. Smart, Capt. F. B. Stevens, Lieut. C. B. Turner, Lieut. J. W. P. Wain ; Jan. 11. Sec. Lieut. C. N. Dilly, Sec. Lieut. F. B. Sagar, Lieut. (actg. Capt.) C. M. White ; Jan. 12. Lieut. S. W. Smith ; Jan. 13. Capt. (actg. Maj) F. P. Scott ; Jan. 15. Lieut. H. E. Chapman (High. R.) ; Jan. 17. Lieut. (actg. Capt.) J. G. Kidd ; Jan. 20.

The following Lieuts. (actg. Capts.) relinquish their commns. on account of ill-health, and are permitted to retain the rank of Capt. :—R. S. De Q. Quincey (contracted on active service), H. Le R. Wallace, D.F.C. (contracted on active service), S. D. Withers ; Jan. 22.

The following Lieuts. relinquish their commns. on account of ill-health, and are permitted to retain their rank :—J. W. Norton, L. E. Owen, W. F. C. Powell ; Jan. 22.

The following Lieuts. relinquish their commns. on account of ill-health contracted on active service :—W. M. Davidson (Can. Local Forces) ; L. F. G. Spencer (Sea. Highrs.) ; Jan. 22.

Sec. Lieut. (Hon. Lieut.) H. Smart relinquishes his commn. on account of ill-health contracted on active service, and is permitted to retain the rank of Lieut. ; Jan. 22.

Sec. Lieut. R. C. De Waal relinquishes his commn. on account of ill-health, and is permitted to retain his rank ; Jan. 22.

The Christian names of Sec. Lieut. Roland Edgar Walker are as now described, and not as in *Gazette* Sept. 10, 1918.

The Christian names of 4409 Flt. Cadet John Purvis Gibb are as now described, and not as in *Gazette* Nov. 22, 1918.

The surname of 128060 Flt. Cadet F. E. W. Davies is as now described, and not as in *Gazette* Nov. 12, 1918.

The names of Sec. Lieut. William Crewdson Walker are as now described, and not as in *Gazette* Sept. 13, 1918.

The appointment of Sec. Lieut. C. E. Irving as Sec. Lieut. (A. and S.) is antedated with effect from June 30, 1918.

The appointment of Sec. Lieut. G. B. McCraig as Sec. Lieut. (A.) is antedated with effect from June 22, 1918.

The date of relinquishment of his commn. by Sec. Lieut. C. McCoombes is Dec. 13, 1918, and not as stated in the *Gazette* Sept. 24, 1918.

The date of relinquishment of his commn. by Lieut. S. G. Robinson is Dec. 20, 1918, and not as stated on page 11978 of the *Gazette* Oct. 11, 1918.

The notification in *Gazette* Nov. 11, 1918, concerning Lieut. (actg. Capt.) W. H. Buckeridge is cancelled.

The notification in *Gazette* Dec. 13, 1918, concerning Lieut. (actg. Capt.) J. G. Coombe is cancelled.

Administrative Branch.

Maj. J. B. Batten, D.S.O., to be actg. Lieut.-Col. whilst employed as Lieut.-Col. ; Aug. 8, 1918.

Capts. to be actg. Majs. whilst employed as Majs. :—H. W. Morgan ; Aug. 5, 1918. H. O. Fellowes ; Sept. 19, 1918.

Lieats. (actg. Capts.) to be actg. Majs. whilst employed as Majs. :—Hon. F. W. Bampfylde (and to be graded for purposes of pay as S.O.2 (2nd Grade)), F. G. C. Fison, O. C. McCaw ; Aug. 8, 1918.

Capt. S. Davenport to be Capt. (from A'ship) ; Dec. 18, 1918.

The following are granted temp. commns. as Capts., seniority April 1, 1918 :—M. L. Fitzgerald (Capt., Cent. Ont. R., C.E.F.) ; Aug. 5, 1918 (substituted for notification in *Gazette* Sept. 13, 1918). P. J. Home-Rigg (Capt., Fife and Forfar Yeo., T.F.) ; Sept. 30, 1918 (substituted for notification in *Gazette* Nov. 1, 1918. Lieuts. to be actg. Capts. whilst employed as Capts. :—W. C. C. Tower ; July 22, 1918. J. W. New (Hon. Capt.) C. W. Wright ; Aug. 8, 1918. A. Reardon ; Aug. 9, 1918. H. E. Burrell ; Aug. 28, 1918. Hon. Capt. R. A. Shepheard Walwyn ; Dec. 11, 1918. T. B. W. Spencer ; Dec. 21, 1918.

Sec. Lieuts. to be actg. Capts. whilst employed as Capts. :—(Actg. Lieut.) P. T. Bond ; July 17, 1918. (Hon. Lieut.) (actg. Lieut.) S. U. Dent ; Sept. 19, 1918. J. H. Boyd ; Nov. 27, 1918. (Hon. Lieut.) H. O. Newland ; Jan. 7.

The following Lieuts. (actg. Capts.) (A.) to be Lieuts., and relinquish the actg. rank of Capt. :—W. G. Stevenson, D.F.C. ; Nov. 12, 1918. W. B. Green, D.F.C. ; Nov. 26, 1918.

J. P. P. L. Biggs (Temp. Lieut., A.P.D.) is granted a temp. commn. as Lieut. ; July 1, 1918, seniority April 1, 1918 (substituted for notification in *Gazette* Oct. 8, 1918).

Lieuts. to be Lieuts. :—J. J. Coleman, from (O.) ; July 1, 1918. A. H. Warton, from (A.) ; Jan. 6.

Sec. Lieuts. to be actg. Lieuts. whilst employed as Lieuts. :—(Hon. Lieut.) C. S. Marriott, (Hon. Lieut.) D. A. Recordon ; Aug. 8, 1918. C. Green ; Aug. 26, 1918. R. E. G. Macmaster ; Sept. 19, 1918. R. E. Cunningham ; Oct. 10, 1918.

Sec. Lieut. E. Bentley to be actg. Lieut. whilst specially employed ; Sept. 16, 1918.

Sec. Lieuts. to be Sec. Lieuts., from (A.) :—S. B. L. Hall ; Oct. 17, 1918. S. Rendle ; Dec. 30, 1918.

Sec. Lieuts. to be Sec. Lieuts., from (O.) :—H. R. Hardcastle ; Nov. 12, 1918. G. A. Faulkner ; Nov. 26, 1918. H. T. Cock ; Dec. 24, 1918.

Sec. Lieuts. (late Gen. List, R.F.C., on prob.) are confirmed in their rank as Sec. Lieuts. :—E. E. Page ; June 7, 1918. A. G. Middleton ; Jan. 8.

Sec. Lieut. R. H. Ramsay is dismissed the Service by sentence of General Court-martial ; Dec. 13, 1918.

The following relinquish their commns. on ceasing to be employed :—Lieut. (actg. Maj.) Hon. F. O. H. Eaton (Lieut., G. Gds.) ; Nov. 29, 1918. Lieut. (Hon. Capt.) W. B. Powell (Capt., Cent. Ont. R.) ; Dec. 6, 1918. Lieut. W. G. Bryan (Sec. Lisut., E. Surr. R.) ; Dec. 12, 1918. Lieut. (Hon. Capt.) W. N. Sloan (Capt., Cameronians, T.F.) ; Dec. 16, 1918. Maj. H. A. Nealon (Maj., Sask. R.) ; Dec. 17, 1918. Lieut. W. A. M. Cox (Lieut., R. Highrs., T.F.) ; Dec. 19, 1918. Capt. Hon. G. W. W. Bampfylde (Capt., N. Devon Yeo., T.F.) ; Dec. 23, 1918.

The following are transfd. to unemployed list :—Maj. Hon. E. Chaplin ; Jan. 1. Sec. Lieut. H. Brighouse ; Jan. 6. Lieut. Hon. Capt.) T. W. M. Cameron ; Jan. 8. Sec. Lieut. (actg. Capt.) R. J. H. F. Beresford, Sec. Lieut. F. C. Brooke-Hunt, Sec. Lieut. F. W. Smith ; Jan. 9. Sec. Lieut. G. R. Hunt, Sec. Lieut. G. E. C. Maconchy, Sec. Lieut. W. W. Pigott, Sec. Lieut. H. B. Smith, Sec. Lieut. W. E. Taylor, Sec. Lieut. W. R. Taylor, Lieut. (Hon. Capt.) J. E. Tomkinson (Ches. Yeo., T.F.), Lieut. (actg. Capt.) W. H. Trinder, Lieut. A. A. M. Weir ; Jan. 10. Lieut. W. A. L. Reaburn, Sec. Lieut. R. F. Winder ; Jan. 11.

Lieut. S. H. Witney relinquishes his commn. on account of ill-health, and is permitted to retain his rank ; Jan. 22.

Lieut. A. G. Bird (actg. Capt., Lond. R., T.F.) relinquishes his commn. on account of ill-health ; Jan. 20.

The following Sec. Lieuts. relinquish their commns. on account of ill-health and are permitted to retain their rank :—G. E. Goodrum ; Nov. 1, 1918. (substituted for notification in *Gazette* Nov. 1, 1918. C. McI. French, V. O. Norman, M. A. V. Pumfrey ; Jan. 22.

The initials of Lieut. G. G. Yeandle are as now described, and not as stated in *Gazette* Nov. 8, 1918.

The surname of Lieut. A. W. Little is as now described, and not Whittle as stated in *Gazette* Dec. 17, 1918.

The surname of Lieut. H. Blackman is as now described, and not Blackburn as stated in *Gazette* Dec. 13, 1918.

Technical Branch.

Lieut. (actg. Capt.) S. N. Veitch to be actg. Maj. (Grade B) while employed as Maj., from (Ad.) ; Nov. 1, 1918.

Capt. (actg. Maj.) F. G. Wilson to be Capt. (Grade B), and relinquishes the actg. rank of Maj. on ceasing to be specially employed ; Nov. 15, 1918.

Capts. to be Capts. (Grade A) :—J. K. Hoyle, from (A'ship) ; April 1, 1918. G. L. Hunting, from (A.) ; Nov. 16, 1918.

Lieuts. to be actg. Capts. (Grade A) whilst employed as Capts. :—F. P., Allbutt, from (O.), W. G. Duffield, L. G. Mace, M. A. Millar, F. Tingle ; July 11, 1918.

Sec. Lieut. (Hon. Lieut.) (actg. Lieut.) A. L. Cockburn to be actg. Capt. (Grade A) whilst employed as Capt. ; Aug. 20, 1918.

Lieut. F. E. Godfrey to be Lieut. (Grade A), from (Ad.) ; Oct. 1, 1918.

Lieut. N. Haig to be Lieut. (Grade B), from (A.) ; July 11, 1918.

Lieuts. (O.) to be Lieuts. (Grade B) :—W. C. Cambray, M.C., R. M. D.

Fairweather, (Hon. Capt.) J. R. Fasson, B. E. Gilbert, G. P. U. Hardy, F. W. Helsby, F. J. Kydd, R. M. Penman, P. R. Smith, R. A. Webster, T. Weir, A. S. White; July 11, 1918.

Sec. Lieuts. to be actg. Lieuts. (Grade A) whilst employed as Lieuts.:—R. W. Ellis, from (O.), J. Milsted, H. F. Weet, from (O.); July 11, 1918.

Sec. Lieut. (Hon. Lieut.) O. S. Waymouth to be actg. Lieut. (Grade B) whilst employed as Lieut.; Sept. 1, 1918.

Sec. Lieuts. (Admin.) to be Sec. Lieuts. (Grade A):—R. J. Kelso; Nov. 28, 1918. H. E. Edwards; Dec. 1, 1918. A. F. Rees, W. Vaughan; Dec. 11, 1918. R. O. Street; Jan. 2.

Sec. Lieut. E. Sidey to be Sec. Lieut. (Grade A), from (A. and S.); Nov. 16, 1918.

Sec. Lieuts. (Admin.) to be Sec. Lieuts. (Grade B):—A. M. W. Leyfield; July 8, 1918. W. J. Brittain; Dec. 3, 1918. F. Williams; Dec. 5, 1918. A. G. Adams; Jan. 13.

Lieut. G. M. Robert to be Sec. Lieut. (Grade B), and to be Hon. Lieut., from (A. and S.); Nov. 21, 1918.

Lieut. O. Clayton to be Sec. Lieut. (Grade B), and to be Hon. Lieut., from (Ad.); Dec. 30, 1918.

The following relinquish their comns. on ceasing to be employed:—Lieut. (Hon. Capt.) J. H. Whittaker-Swinton (Lieut., R.E., T.F.); April 17, 1918. Capt. L. J. Rogers (Temp. Lieut., R.N.V.R.); Oct. 28, 1918. Sec. Lieut. (Hon. Lieut.) W. L. Heape (Lieut. E. Lanc. R.); Dec. 11, 1918. Sec. Lieut. J. H. G. Wilson (Sec. Lieut., R.E.); Dec. 16, 1918. Lieut. G. Elliott (Lieut., Yorks L.I.); Jan. 1. Sec. Lieut. (Hon. Lieut.) G. E. Patterson (Lieut., Alberta R.); Jan. 8.

The following are transfd. to unemployed list:—Sec. Lieut. J. A. Osborne Jan. 2. Sec. Lieut. D. M. Harvey; Jan. 3. Sec. Lieut. C. G. L. Colebrook, Sec. Lieut. T. S. Nash; Jan. 7. Sec. Lieut. F. G. Crowley, Capt. Sir E. de la Rue, Bt.; Jan. 8. Sec. Lieut. E. E. Blake, Capt. P. G. Gundry, Sec. Lieut. F. V. Harrap, Maj. J. T. Spittle; Jan. 9. Lieut. (Actg. Capt.) J. J. V. Armstrong, Lieut. C. Atkey, Sec. Lieut. A. W. Cordrey, Sec. Lieut. Sir H. G. D. Bathe, Bt., Capt. (Actg. Maj.) F. W. M. Pedley, Lieut. F. G. Tryhorn, Sec. Lieut. B. Williams; Jan. 10. Capt. C. G. Ashton, Sec. Lieut. (Hon. Lieut.) J. G. Daniel, Sec. Lieut. A. E. Dyson, Lieut. (Actg. Capt.) E. G. Herbert, Lieut. (Hon. Capt.) R. M. Knowles, M.C. (Capt., Norf. R.), Sec. Lieut. (Actg. Lieut.) W. R. Rhodes, Lieut. (Actg. Capt.) W. J. R. Sheppard; Jan. 11. Sec. Lieut. (Actg. Lieut.) S. G. Yapp; Jan. 12. Lieut. L. G. Courage, Capt. R. K. C. Maguire, M.B.E., Sec. Lieut. F. M. Roberts, Lieut. S. L. Smith; Jan. 13. Sec. Lieut. A. H. Turner; Jan. 20.

Lieut. (Hon. Capt.) E. M. Wright relinquishes his comn, on account of ill-health contracted on active service, and is permitted to retain the rank of Capt.; Jan. 22.

Capt. (Actg. Maj.) P. H. Linthune (Lond. R.) relinquishes his comn. on account of ill-health contracted on active service; Jan. 22.

Sec. Lieut. W. T. Langton relinquishes his comn, on account of ill-health and is permitted to retain his rank; Jan. 22.

The date of appointment of Actg. Lieut. McL. N. Staight is Oct. 1, 1918 and not as in *Gazette*, Nov. 5, 1918.

The notification in *Gazette*, Nov. 12, 1918, concerning Sec. Lieut. F. P. D Scott is cancelled.

"VICTORY IN THE AIR"

IN celebration of the British Empire's Victory in the Air, a banquet was held under the auspices of the Imperial Air Fleet Committee on January 21. Lord Desborough presided, and was supported by Major-Gen. J. E. B. Seely, D.S.O., M.P., Under-Secretary of State for Air; the Hon. Sir Thos. Mackenzie, K.C.M.G., High Commissioner for New Zealand; Major-Gen. Sir W. S. Brancker, K.C.B., A.F.C.; Lieut.-Gen. Sir R. E. W. Turner, V.C., K.C.B., K.C.M.G., D.S.O.; Gen. Sir W. R. Birdwood, G.C.M.G., K.C.B., C.I.E., D.S.O., A.D.C.; Major-Gen. E. B. Ashmore; Sir W. A. Robinson, K.C.B.; Brig.-Gen. E. M. Maitland; Brig.-Gen. R. K. Bagnall-Wild; Alderman Sir C. C. Wakefield; Lieut.-Col. M. O'Gorman; Lieut.-Com. H. Perrin; Messrs. T. O. M. Sopwith, F. Handley Page, G. Holt Thomas, Claude Johnson, H. White-Smith, Claude Grahame-White, A. W. Gamage, etc.

After the loyal toasts had been drunk Lord Desborough proposed "The British Empire's Victory in the Air."

Major-General Seely, in responding, said that it was five years since he had addressed a public gathering at a dinner. Indeed, he had almost forgotten how to do it; but if ever a man had a good toast to respond to this was a glorious one—the British Empire's victory in the air. In the winning of the war no greater credit was due to anyone than to the British airman. In this connection he thought names should be mentioned, such as Sir David Henderson, Gen. Sir H. Trenchard and Major-General Sir Frederick Sykes. Looking back, all one could say was that their work was well done. Although little had been done in the early days of the War in comparison with what might have been achieved, there was a flash of truth in General French's first dispatch, in which he paid a glowing tribute to our airmen in the first months of the War. Things had developed since then, and a tribute was due to the flying men who had come from all parts of the Empire. As had been said to him, "There is only one fault with our airmen. They are too brave." He (Major-Gen. Seely) had been speaking that day to Gen. Sykes, and he asked him if in connection with the Air Service he could pick out any part of the Empire for outstanding valour. His reply was, "You cannot." "Representatives of the Dominions," Gen. Seely said, "did well, but we at home did our best also. Indeed, the whole race rose to the highest point in asserting supremacy in the air—will, energy, heart, spirit. So we won, thank God, we won. And now we will not lose the advantage that victory has given us. The same unity of purpose that has been ours through the years of war will be ours in years of peace to come. We shall have to have Air Forces for military purposes still. People say to me, 'You must have an Air Force equivalent to the land and sea forces.' I say, 'Yes, but it would be wise to have an even greater proportion of Air Force.' The armies of the future, so it seems to me, should be maintained by a League of Nations to coerce all those who dare to break the world's peace—they will be armies, in proportion to their numbers, more mechanical and with more power in the air. Science must be wedded to the art of war in order to ensure the peace of the world. That, I am sure, will be done, and all the best brains at our command will be devoted to that end. But, having done that, and having ensured, I hope, in this great air service, that our Dominions, in forming their own air service will form it in connection with ours, so as to have one great air fleet, as we have one great fleet on the sea, we must make sure that the air supremacy we have gained shall be used for the good of mankind instead of only for the destruction of life. I can promise you on behalf of the Secretary of State for the Air and of the Air Council that every effort will be made to help forward the air traffic of the future. Plans have been made in most elaborate detail for helping forward the air traffic of the future. Among the things we must and can do one is to secure great air routes between the Dominions of the Crown. I see no reason why within the lifetime of nearly all of us there should not be air routes between almost all parts of the British Empire. All that will not come at once, but if you have got a good plan, and if you work to that end, and if you have got a soft-hearted Treasury, which I hope to find, and on which I shall ask for the support of the House of Commons, I am sure we can build up a service not only as good as but far better than that possessed by any other nation."

In this effort to increase air traffic throughout the world for the good of the world at large (he concluded), we meant to secure the first place in a generous rivalry.

Gen. Brancker, supporting the toast of "Our Future Imperial Air Fleet," said throughout the War aviation had proved its increasing importance. In the next five years that proportion of importance would increase. He felt the future of the Empire lay in the air. He had always said aviation was to win the War. He was wrong, but he honestly believed that if the Germans had not overstrained their resources in their offensive aviation would have won the War. In the aviation of the future we had a wonderful incentive in that the British Empire was scattered all over the world, and if proper touch was to be kept we had to develop aerial commerce. It was because he felt that commercial aviation was the line to pursue that he had cut himself away from military aeronautics. There were untold possibilities in commercial aeronautics, and it was to be an enormous success in the end. But there were many troubles and difficulties to get over. To have really prosperous commercial aviation they must make it pay. In order to make it pay they had to create a great organisation. They had to prove to the public that it was safe and reliable; that it would do what it was said it would do. A great deal of capital would be required, and a great deal of patience. Aviation was going to keep the Mother Country in real and close touch with the Overseas Dominions.

There seemed to be an impression that aviation was to be a rival to steamship lines and cables. It was not. Trade was increasing on every side, and aerial transit to every part of the world was coming as a supplement and not as a rival to other forms of transportation. It would provide the really hard-working business man with the means of journeying from one side of the world to the other.

Mr. Holt Thomas, speaking on behalf of the aircraft industry, asked the Government to withhold permission for commercial aviation until there was time to create a proper organisation. If accidents occurred progress would be hindered. Commercial aeronautics would bring Melbourne within four days of London, and he saw no more difficulty in flying to Melbourne than in maintaining the present aerial service to Paris.

SIDE-WINDS

THE GRAHAME-WHITE COMPANY, Ltd., have now organised a very complete and well-equipped Motor Car Repair Department at their extensive factory at Hendon, providing accommodation for over 500 cars. This department is under the direct supervision of Mr. H. P. G. Brakenridge, late of Messrs. Ba ker and Co., and already the department is in full operation, some 100 cars at the present time being renovated. The company has also started a high-class coachbuilding department, while another department is set aside for the production in large quantities of bodies of the taxi-cab type.

The Grahame-White Co. has also opened Show Rooms at 12, Regent Street, Pall Mall, under the control of Mr. Leonard Williams, for many years a director of the Brompton Motor Co., who handled the Benz cars in Great Britain. Mr. Williams has taken over the management of the Sales Department. We understand that the firm is also taking up the design and manufacture of a light car.

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THE staff and employees of Messrs. Arnott and Harrison, Ltd., held their first Social and Dance at the Pavilion Hotel, Wormwood Scrubbs, on the 22nd inst. Commencing with a high tea, the company proceeded to enjoy the entertainment provided. The boys of the firm put up two smart turns in the "A. and H. Minstrels" and "The Jolly Boys" troupe, while the drawing-office staff gave a pierrot sketch. A whistling contest for both sexes provided much amusement; the refrain from "The Policeman's Holiday" was the test-piece, and Mr. F. H. Arnott, who took charge of the proceedings, was attired in the uniform of a member of the force. Mrs. Arnott gave the prizes. Among the other items on the programme which were evidently appreciated were Mr. Hives (The Aircraft Manufacturing Co.), Mrs. Dorothy Knowles, Mr. Robert Sinclair, and Miss Harford. Mr. Harry Taylor (Air Ministry) presided at the piano throughout. A vote of thanks to Mr. Clifford Thompson, the entertainment secretary, was passed in rousing fashion, leaving him in no doubt as to whether his efforts had been appreciated.

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WE are informed that the name of the firm which has hitherto been known as Sir Joseph Jonas, Colver and Co., the well-known makers of alloy steels for aircraft, of the Continental and Novo Steel Works, Sheffield, has now been changed to Jonas and Colver, Ltd.

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THE Central Aircraft Co., of 179, High Road, Kilburn, N.W. 6, which has won a considerable measure of fame for excellence of workmanship in aeroplane construction, will shortly be opening a School of Aviation. This new venture will be under the personal supervision and management of Mr. Herbert Sykes, O.B.E., the well-known test pilot, and the training will be carried out on 75 h.p. dual-control "C.A.C." tractor biplanes. Under the able directorship of Mr. R. Cattle, the Central Aircraft Co. have certainly contributed a full share in the work of supplying the R.A.F. with the machines necessary to maintain supremacy in the air, and no doubt the pilots produced by the new school will be as excellent in quality as the machines turned out by the old firm.

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THE enclosed D.H. 4 biplanes which are used by the Peace delegates when travelling between London and Paris should one day become historic machines, and it is not surprising that Messrs. Adam, Grimaldi and Co., Ltd., of Albert Works, Glasshouse Street, Albert Embankment, S.E. 11, are proud of the fact that they manufactured the *fuselage* complete with all interior wood fittings, petrol and oil tank, ammunition-boxes and chute for machine gun, together with top wing centre section. They fitted undercarriage and wheels, joy-stick and rudder controls, and also the tail plane and elevating gear.

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THE Sun Electrical Co., Ltd., writing us in regard to a small paragraph which we inserted last week, drawing attention to the charming calendar for 1919 issued by them, say: "In your issue of January 23, you were good enough to insert a notice respecting our calendar. Unfortunately for us, you appear to have a very large circle of readers, with the result that we have been simply inundated with applications for these calendars. It is unfortunate, because the edition of calendars has now been exhausted, and we shall be glad if you will insert a small par. on our behalf intimating that as far as possible applicants have received a copy of the calendar, but a large number of applicants have necessarily been left over." So will readers please note and accept this as an apology for their applications being unfilled: These days it is indeed a case of "the early worm," etc.

Advisory Committee Reports

NUMEROUS applications for technical information having been received since the armistice, the Deputy-Controller of the Technical Department Aircraft Production, Ministry of Munitions, desires it to be generally known that arrangements are being made for the early publication through H.M. Stationery Office of all technical reports and data. These documents will be "Advisory Committee Reports," but will be issued separately as ready. They will also be published in volume form annually.

Arrangements are also being made for the preparation and early publication of a new series of reports and memoranda embodying the information and experience that is already covered by existing reports.

Greek Airman Missing

COMMANDER ARISTIDE MORAININIS, a Greek flying officer, who left Salonica with the intention of flying to Athens, has not arrived at his destination, and has been officially posted as missing.

NEW COMPANIES REGISTERED.

AERO AND GENERAL PUMP MANUFACTURING CO., LTD., Finsbury Pavement House, E.C.—Capital £5,000, in £1 shares (1,000 7½ per cent. cumulative preference and participating). Manufacturers of and dealers in pumps for aero, marine and other engines, etc. First directors: F. W. Webb, N. G. Boggs, H. D. Grant and L. A. Whitby.

EASTON, LLOYD AND CO., LTD., 187-8, Broad Street, Birmingham.—Capital £20,000, in £1 shares. Dealers in internal combustion engines, automobiles, aircraft, etc. First directors: N. S. R. Easton, U. E. Lloyd and G. P. Zair.

GRAHAM FRANCE AIRCRAFT PATENTS, LTD.—Capital £15,000, in £1 shares. Manufacturers of flying machines, aeroplane parts and accessories, dynamos, accumulators, batteries, etc. Permanent directors: A. Graham France, W. M. Rolph and D. Brooks.

SUTHERLAND PILCH, LTD.—Capital £10,000, in £1 shares. Manufacturers of and dealers in motor cars, cycles, flying machines, etc. First directors: H. Sutherland Pilch (managing director), F. Shearman, F. E. Lewis and H. A. Coaton.

Aeronautical Patents Published.

Abbreviations:—cyl. = cylinder; I.C. = internal combustion; m. = motors

APPLIED FOR IN 1917

The numbers in brackets are those under which the Specifications will be printed and abridged, &c.
Published January 30, 1919.

6,434. W. and W. L. PRIOR and J. S. GIBSON. Manufacture of hollow and other articles from wood laminae. (121,750.)

APPLIED FOR IN 1918

The numbers in brackets are those under which the Specifications will be printed and abridged, &c.
Published January 30, 1919.

122. C. MAICHE. Means for stopping way or maintaining equilibrium of aeroplanes. (112,775.)

1,081. R. G. JAKEMAN. Protective garments or coverings for airmen (121,838.)

Index and Title Page for Vol. X.

The 8-page Index for Vol. X of "FLIGHT" (January to December, 1918) is now ready, and can be obtained from the Publishers, 36, Great Queen Street, Kingsway, W.C. 2. Price 8*d.* per copy, post free.

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